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	TITLE ANALYS	SIS - EFFECT OF DEPTH INCREAS	E. LAUNCH TUBE.
	MING A		
	MODEL NO.	WS-133A CONTRACT NO	AFOL(614)-289
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TABLE OF CONTENTS

	TITLE	PAGE
	REFERENCES	6
1.0	PURPOSE AND SCOPE	7
2.0	STUDY PARAMETERS AND SUMMARY	. 7
3.0	MISSILE PERFORMANCE	8
h.0	LF (RPIE) EFFECTS	9
5.0	OGE EFFECTS	IJ
6.0	MGE EFFECTS	16
7.0	HUMAN ENGINEERING ASPECTS	20
8.0	ACO EFFECTS	47
g.n	TEST PROGRAM	50

LIST OF ILLUSTRATIONS

ILLUSTRATIONS	TITLE	PAGE
4.1	VAFB Launcher Pictorial Comparison	13
#*5	Operational Laumeher Pictorial Comparison	371
6,1	Work Cage/Power and Communications Cable Limitations	18
6.2	Work Cage/Hoist Cable Limitations	19
7.3	Missils Base Support Leveling	21 - 23
7.2	Dond Band Leveling	24 - 26
7.3	Sump Pump Handling and Maintenance	27 - 32
7.k	Work Cage at Sile Base	33 - 36
7.5	SIN J - Beek	37
7.6	Security Transducer	38
7.7	Missile Removal	39 15
8.1	ACO 216 Revision	48
8.2	ACO 215 Revision	49

LIST OF REFERENCES

D2-4979	Volume I, "Sile Launch Verification - Gas Dynamic Stability Characteristics - W5-133A - Minuteman", to be revised 15 July 1963
D2-4979	Velume II, "Sile Lammeh Verification Missile Clearance - WS-1334 Minuteman" to be revised 1 September 1963
D2-11:136	Volume III, "Ming VI Launch Pressure Environment"
D2-11:137	Volume IV, "Ming VI Launch Thermal Environment"
D2-14730	"Dynamic Analysis of Wing II Minuteman Missile Launcher Mount + Figure A 1322" (Revision A)

1.0 PURPOSE AND SCOPE

This deement presents the results of evaluation of Wespon System compatibility with the 10 foot desper launch tube at Wing V. Included are data reflecting missile launch performance, launcher configuration, maintenance requirements, and human factor considerations. Wing V launchers are designed; therefore, this document covers only those studies and mandatory hardware changes necessary to accommodate the 10 foot increase in depth of the launch tube.

It should be noted that this document merely summarizes the effects of the deeper launcher. In many instances, substantiating data will be found in the established Wing V documentation. In particular, reference must be made to missile performance and dynamic study documents (noted in paragraphs 3.0 and 5.0 and listed in the list of references) and, in Paragraph 2.2.2, to the Engineering Change Proposals for complete substantiating data.

- 2.0 STUDY PARAMETERS AND SUMMARY
- 2.1 BACKGROUND
- 2.1.1 This study has been conducted in accordance with STL Document 6660.12-31 dated 3 January 1963. The study evaluates the Weapon System for compatibility with the Wing V Launch tube which is 10 feet desper than those in Wing I to IV. Authorization for this study was given by CCP 815, CCN 816 (BSD-63-MSW-6904).
- 7.1.2 The vertical location of the missile in the deeper tube will be identical to that of the Ming I through IV configuration. Refer to Figure 4.1 and 4.2 (Page 13 and 14).
- 2.1.3 The missile will be the Wing II configuration.
- 2.1.4 Only the Weapon System changes made mandatory by the deeper launch tube are considered in this study. No other proposed Wing V changes were considered.

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- 2.1.5 Three areas of Weapon System effects were evaluated:

 Effect on missile performance, effect on system hardware and mandatory changes, and man machine relationships.
- 2.2 STUDY RESULTS SUMMARY
- 2.2.1 It is predicted that Missile performance, including dynamics and fly-out trajectories, is not adversly affected by the Wing V sile.
- 2.2.2 The fellowing hardware changes are required:

FIGURE A NOMENCLATURE		CHANGE		
1248	Cable Set, Launcher	EGP 518		
1322	Missile Suspension System	BCP 559		
holi3	Elevator Work Cage	ECP 539 KL		
A00 215	Hele Locating Fixture	18CP 559		
A00 216	Loading Fixture	BCP 559		

- 2.2.3 No human-factors problems are evident.
- 2.2.4 System verification testing is required at VAFB.

- MISSILE PERFORMANCE 3.0
- 3.1 GAS DYNAMIC STABILITY CHARACTERISTICS
- 3.1.1 Cold flow testing was not conducted. Existing cold flow data from Wing II and Wing VI tests will be analyzed so that Wing V gas dynamic stability characteristics may be defined.
- 3.1.2 The data will be published by July 15, 1963 and will appear as a revision to D2-4979, Volume I "Sile Launch Verification - Gas Dynamic Stability Characteristics -WS-133A - Minuteman".
- 3.2 KEY-OUT TRAJECTORY AND CLEARANCE
- 3.2.1 The missile fly-out trajectory and the nextle/nount relative notion will be studied using the gas dynamic characteristics developed as noted in paragraph 5.1 (above).
- 3.2.2 Design clearance envelopes will be defined.
- 3.2.3 The data will be published by September 1, 1963 and will appear as a revision to D2-4979, Volume II "Sile Launch Verification - Missile Clearance - W5-133A - Minutesane.
- He fly-out clearance problems are expected. This conclu-3.2.4 sion is based on analyses conducted to date on the Wing I and Wing II missile launches. The deeper launcher should reduce the magnitude of gas dynamic forces and mements acting on the missile. This should make the skirt/sile elegrance greater than the Wing I or Wing II lamenes. Definition of the actual Wing V launch trajectory will be previded, however, to verify that there is no clearance problem.
- 3.3 THERMAL AND PRESSURE ENVIRONMENT

Review of the in-sile pressure and thermal environment showed that despening the launcher reduced both blast wave everpressure and missile heating rates .. We pressure or thermal environmental problems will result from a 10 foot deeper launch tabe with the missile remaining at the same level relative to the top of the launch tube.

These conclusions are based on studies made of Wing VI missile retrofit into Wing II launchers. D2-11137 Volume IV, "Wing VI Thermal Environment" and D2-14136 Volume III, "Wing VI Pressure Environment" show a more severe environ... ment exists with a Wing VI missile in a Wing II launcher than in a Wing VI launcher (which is the same depth as Wing V launcher). Refer to Figure 4.1.

- 14.0 LF (RPIE) EFFECTS
- Wing V RPIE and LF Facilities were investigated for functional compatibility with the Weapon System. It should be emphasized that Wing I IV RPIE is not required to be used at Wing V but rather Wing V RPIE requirements are set forth as a separate entity to satisfy a new facility configuration.
- h.2 Launch Tube requirements are defined by the "Facilities"
 Design Criteria".
- 4.2.1 RPIE, Material, and Construction Specifications and details are defined by the BSD/AE plans and specifications.
- h.2.2 Boeing had reviewed the A/E drawings for hardware and interface compatibility prior to construction contract award. Wing V facilities design was concurred with and recommendations given.
- he3 Specific areas of concern in regard to the affects of the 10 foot deeper launcher are as follows:
- 4.3.1 Environmental Control System (ECS)
 - (a) Launch Tube heating requirements are a function of ground temperature and tube area. Ground temperature with depth and season, but is essentially equal to well water temperature in the site area and stablizes at about 30 feet. Malmstrom AFB ground temperature is about 12 to 13 F. Warren AFB ground temperature is about 12 to 13 F. Warren AFB ground temperature is about 17 F. (from ASHRE Guide, 1552). Thus, although Wing V launchers have approximately 380 square feet more heat transfer area than Wing I launchers, the total heat loss of the two launchers is comparable.
 - (b) The 4.5 KW launch tube heater will be as adequate at Wing V as at previous Wings. The ten foot additional length of the air duct would have less than a 15 reduction affect on air flow and not heat imput.
 - (e) Although the deeper launcher does not materially affect the heat and power leads associated with the LF EGS, the proposed EGS (Figure A 1211.3) for Wing V appears deficient in certain other aspects. These deficients

investigated. They are not analyzed here because the same problems are as applicable to Wings III and IV as they are to Wing V.

4.3.2 Sump Pump

- (a) The static head due to the increased depth . on sump pump (SP-102) is 10 feet greater at Wing V compared to Wing IV. The friction head due to flow through the 10 foot longer discharge line is one half foot greater. Therefore, the total discharge head on the pump at the same flow is increased 10.5 feet.
- (b) Parsons drawings P-1 for both Wing IV and Wing V call for a pump capable of discharging 20 gpm against a total discharge head of 105 feet. The requirement cannot be the same at both wings.
- (c) The Corps contractor's shop drawings show the same pump at both wings in accordance with the Parsons requirements.
- (d) Calculations by Boeing estimate the total discharge head requirement at Wing V to be 104.5 feet and at Wing IV 93.0 feet.
- (e) Conclusion: The specified sump pump is satifactory at Wing V. It is noted that the pump delivery at Wing IV will be approximately 35 gpm.

4.3.3 Missile Suspension System Interface

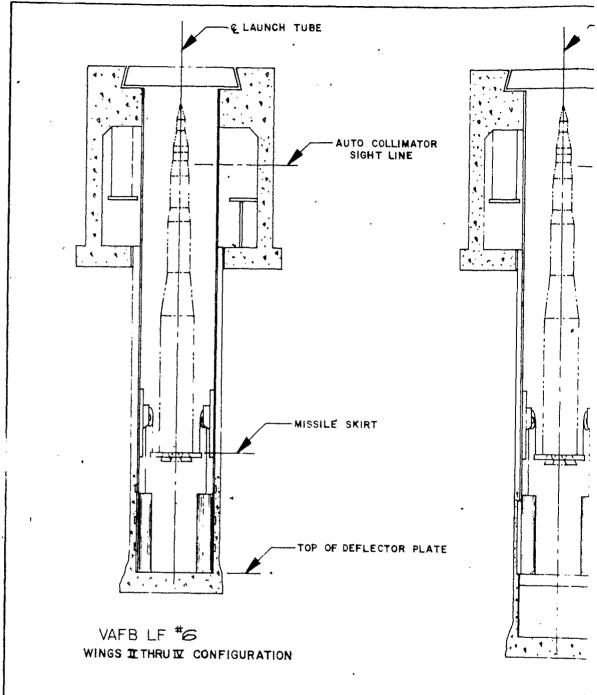
(a) Provisions have been provided in Wing V LF for proper attachment of the suspension system.

- (b) Refer to paragraph 5.1.4 for OGE analysis.
- 4.3.4 Security Motion Transducer
 - (a) The vibration sensor Junction Boxes are located in the same relative position as required in Wings I through IV. This places them 10 feet higher relative to the bottom of the silo. Reference:

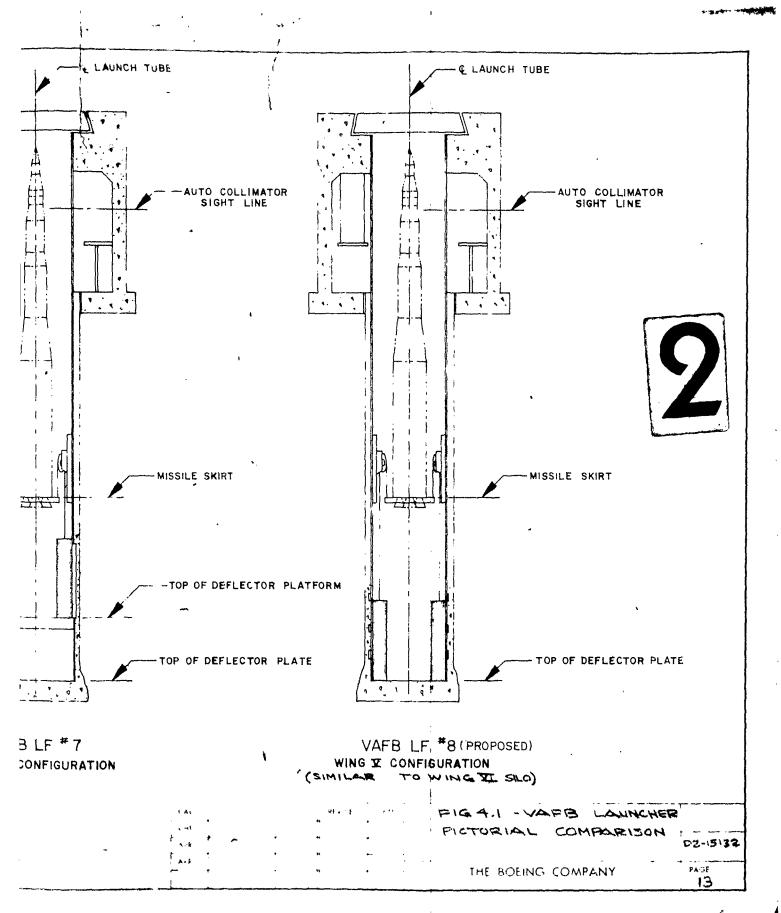
 A & E drawings and ICD 25-35211.
 - (b) This location appears to be satisfactory. Penetration into the launch tube at the lowest 10 feet is unlikely. Also, the sensors are extremely sensitive (enough to preclude unauthorized entry at this depth.
- 4.3.5 Missile Base Ground Tie Box

This box is correctly located relative to the missile mounting ring.

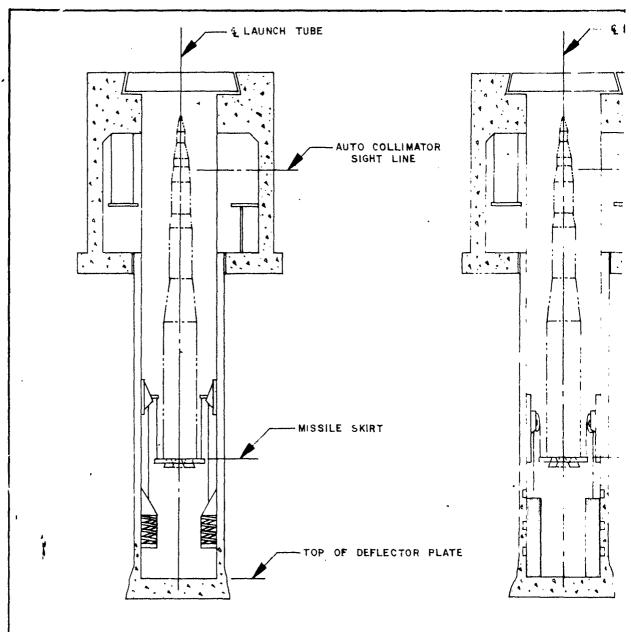
4.4 See Figure 4.1 and 4.2 for a pictorial comparison of VAFB and operational launchers.



VAFB LF * WING TT CONFIGE

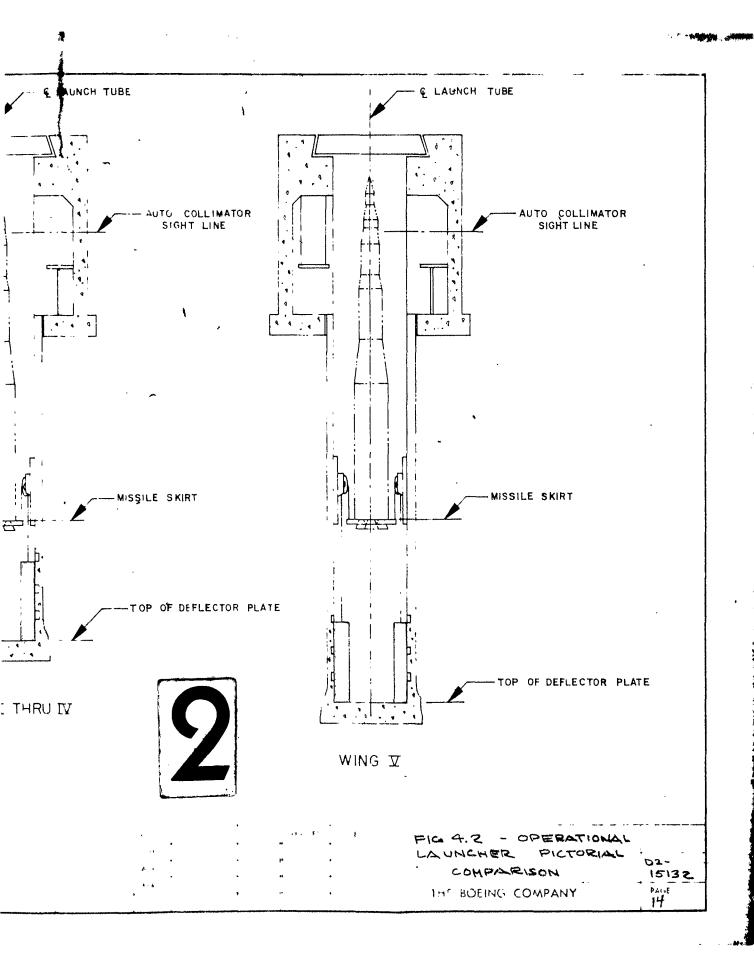


... ml a management



WING I

WINGS II THRU



5.0 OGE EFFECTS	
5.1 FIGURE A 1322	- MISSILE SUSPENSION SYSTEM
	er cables and suspension cables must be .0 feet to allow for 10 foot deeper
(due to cable are required t nor the torsic	ical spring rate, and tether spring ratelength change) is negligible. No change the tether springs, suspension springs bars. The tether and suspension cabonot be changed.
may be found i Minuteman Miss (Secret). It	alysis for the missile suspension system D2-14730 "Dynamic Analysis of Wing I ile Launcher Mount - Figure A 1322" will be seen from this analysis that roblems with the redesigned system in noher.
	en established to procure hardware to A (1322.5) for Wing V.
5.2 FIGURE A 1248	- CABLE SET, LAUNCHER
tube. W720 is	a telephone communication cable running. 428 and Unit No. 426.
5.2.2 The cable will intrasite cable	be revised under ECP 518, "Redesign of e system for facility difference at Wir

No other item of OGE is affected by the 10 foot increase in launcher depth.

5.3

J3 407 1000 (was BAC 1546 L R3)

- 6.0 MGE EFFECTS
- 6-1 FIGURE A LOL3 ELEVATOR WORK CAGE
- 6.1.1 Use of the Elevator-Work Cage in the ten foot desper launcher of Wing V is limited by the length of the two cables: (1) The Power and Communication Cable and (2) the Hoist Cable
- 6.1.1.1 Figure 6.1 and 6.2 show the limiting factors to be as fellows:

Power and Communication Cable

- (a) With the present routing of the Pewer and Communication Cable, the Work Cage would be one foot 112 inches short of reaching the nominal launcher depth (see Figure 6.1).
- NOTE: Nominal dimensions of the launcher from A & E drawings as shown in Figure 6.2.
- (b) By rerouting the cable inside the Work Cage, the cage could descend a maximum of one-half inch beyond the nominal launcher depth.

Hoist Cabla

US 30" - 1006 WAS BAC 1546 L R3)

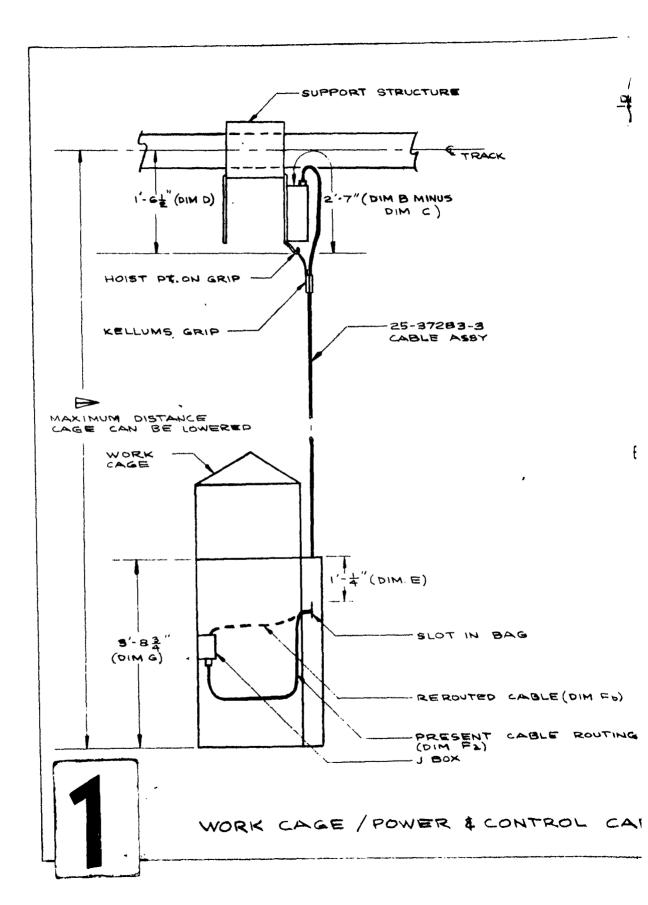
- (a) The hoist cable allows the bottom of the Work Cage to reach 11 inches beyond the nominal launcher depth (see Figure 6.2)
- (b) Fully extended, the bearing point of the hoist hook will reach 5 feet 5½ inches short of the nominal bottom of the launcher.
- 6.1.1.2 From meager available data, Liaison has provided field measurements showing the following:

Whiteman launch tube depth 1.58 inches greater than nominal.

Ellsworth launch tube depth in excess of 1.25 inches greater than nominal.

This information indicates that the launchers may not be more than an inch or two deeper than nominal.

- 6.1.2 The Power and Communication Cable must be rerouted to allow the Elevator-Work Cage to reach neminal bottom in the ten foot deeper launch tube. Since there is only about one-half inch to spare and extra length should be supplied for cut-off when connector ends are repaired, it is recommended that the cable length be increased by adding approximately seven foot extension to be permanently installed in the Work Cage.
- 6.1.3 In addition to hoisting workmen and tools, the Elsvator Work Cage is used as a hoist during maintenance of the sump pump located in the bottom of the launcher. This is in accordance with procedures set up by Form "C" No. 1209 (D2-6951 Volume IV G).
- A one-half inch hemp rope is to be used to secure the 6.1.3.1 hoisted part to the Elevator Work Cage. This provides flexibility in reaching the sump pump from the hook on the work cage hoist line, which is five to six feet above the bottom of the launcher.
- 6.1.3.2 Replacement of the present Elevator Work Cage hoist cable for these stated uses is not recommended as being required for use in the Wing V launcher.
- 6.1.4 It should be noted ECP 539R-1 is being submitted and ten feet additional cable is being proposed in accordance with Air Force request. If ECP 539R-1 is incorporated, there will be no requirement to extend the capabilities of the Elevator-Work Cage under CCP 815.
- NO OTHER ITEMS OF MGE ARE AFFECTED. 6.2



DIMENSION

TABLE

DEM	DESCRIPTION	VALUE
×	MIN LENGTH OF CABLE 25-37283-3 PER ADEN & TO 25-37283	83'-0"
8	FROM END OF CONNECTOR TO BOTTOM FIND OF KELLIMS GRIP (P/N 50-9)	3'-8"
C.	BOTTOM END TO HOIST PT ON SDIP GRI	P 1'-1"
D	FROM & TRACK TO BEARING POINT OF HOOK SUPPORTING, GRIP (PER GS4080 SI	1-62"
E	TOP OF BAG TO TOP OF SLOT IN BAG	1'-4"
=	CABLE FROM STOT IN BAG TO J BOX	
	3 - PRESENT (PER D ON 25-18039)	6'10"
	b-REROUTED	4' 10"
Œ	(PER 25-18605)	3. B 3"

MAX, WORK CAGE LOWERING ALLOWED BY
POWER & CONTROL CABLE



- I PRESENT CABLE ROUTING: = DIMA - (E +F2+ (B-C))+D+G = 77 FEET - 10 INCHES
- 2. POSSIBLE BY REROUTING CABLE WITHIN CAGE:
 = DIMA (E + Fb+(B-C)) + D + G
 = 79 FEET 10 INCHES

(REF: LAUNCHER NOMINAL DEPTH WINGT 79 FEET-92 INCHES

1 = 6)

DAITUC

CABLE	LIMITATIONS
-------	-------------

FIGURE G. I	
	15132
THE BOHNG COMPANY SEATTLE 24, WASHINGTON	PAGE 18

HOTES

- 1. LAUNCHER DIMENSIONS FROM ARE DRAWINGS:
 MALMSTROM SHT S-19 & 5-32; ELLSWORTH, MINOT,

 & WHITEMAN SHT S-19 & S-39; VAFB SHT S-20 &5-34;

 & WARREN SHT S-19 & S-39.
- 2. ALL LE DIMENSIONS ARE NOMINAL. FIELD CHECK
 SHOWS THAT IST LEVEL EQUIP ROOM CEILING
 TO BOTTOM OF LAUNCHER WAS 1.58 INCHES
 GREATER THAN NOMINAL AT WHITEMAN AND
 1.25 INCHES GREATER THAN NOMINAL AT ELLSWORTH
- 3. THE HOUT HOOK WILL REACH TO THE
 BOTTOM OF THE LAUNCHER AT WINGS IT. IX
 AND MICHT BE USED FOR LIFTING ITEMS
 OTHER THAN THE WORK CAGE, THE HOOK
 WILL BE 5'5' SHORT OF LAUNCHER
 BOTTOM AT WING X

73'-8" PER 10-20862 PARAGRAFH 3.1.6.6

BEARING POINT OF HOOK CAN EXTEND 3'-101"

BEYOND NOMINAL DEPTH OF LAUNCHER

WHEN LOWER LIMIT SWITCH IS ACTUATED

BEARING FOINT OF HOOK WILL BE 5'-51"
FROM MOMINAL DEPTH OF LAUNCHER WHEN
LOWER LIMIT SWITCH IS ACTUATED

2

FIGURE G. 2 - WORK

CAGE /HOIST LIMITATIONS DZ15132

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19

69'-91"

E) **\$** Launcher

3>

7.0 HUMAN ENGINEERING

- 7.1 Detailed task analyses were performed on the following functions to determine if any human engineering problems were created by the 10-foet extension of the launch tube.
 - A. Rissile Base Support Leveling
 - B. Dead Band Leveling Missile Base Support
 - C. Sump Pump Installation, Removal & Maintenance
 - D. Work Cage Utilisation
 - E. Installation and Maintenance of the SIN Inter-Communications J-Box
 - F. Installation and Maintenance of the Motion Sensing
 Transducers
 - G. Missile Installation and Removal
- 7.2 The analyses (Fig. 7.1 through 7.7) indicate that no significant human engineering problems are oreated by the launch tube extension.
- 7.3 An increased utilization of the elevator work cage is predicated on the basis of using it to perform skirt umbilical
 remove and replace functions for which a step ladder is now
 employed. The additional 10 feet will make the use of a
 stepladder unrealistic.

	FUNCTION: A MISSILE BASE SUPPORT LEVELING	Perceptual Requirements	DECISION REQUIREMENTS
1)	Three members assemble work cage		
2)	Place vapor-proof flood lamps in	Vision, hearing,	Number of ligh
	work area on second level and	touch. Illumina-	required, what
	secure to provide light in lower	tion such that	wattage, i.e.
	launch tube area.	glare is reduced	75 to 300 wat
		by lamp adjust-	available.
		ment at 2nd level.	
3)	Enter elevator work cage and		
	descend to missile base.		•
4)	Verify that first stage missile	Vision, touch.	Whether prope
	skirt grounding strap, located		connection is
	near skirt umbilical restraint		made.
	bracket is connected to missile		
	support ring adapter.		•
5)	Verify that ground cable is	Vision, touch.	Is a proper
	connected between ground strap	Are junction box	earth ground
	located on outside of missile	connector lugs	established.
	support ring adapter and one	free of corrosion.	
	of the cable connector lugs in		
	missile base ground point junc-		
	tion box.	· · · · ·	
5)	Using first stage skirt re-	Vision, touch	Which levelir
	straint clamp bolt holes, in-	·	jack to orier
-	stall missile base support		to - jack 1,
	level set on missile support		or 3.
	ring adapter so that levels are		*
	oriented to one of three level-		
	ing jacks.		

^{*}See detailed Task Analysis for work cage, page 33

Programme Commencer

Perceptual Requirements	DECISION REQUIREMENTS	ACTION WORK FORCE	COMMUNICATIONS REQUIREMENTS	SAFETT REQUIREMENTS	· PROBABLE EHRORS
Vision, hearing,	Number of lights	Attach lights by	Voice communication	Safety lanyards	Minjudging light
touch. Illumina-	required, what	screwing and ad-	between operators.	attached when work-	ment for glare-fr
tion such that	wattage, i.e.,	justing clamp.	No visual links in	ing in sile on work	illumination at s
glare is reduced	75 to 300 watts		this location.	cage and attaching	bottom.
by lamp adjust-	available.			lights.	
ment at 2nd level.					•
			,		•
					:
					:
				•	
Vision, touch.	Whether proper		Voi ce	₹ •	Insecure ground
	connection is				attachment.
. <u>.</u>	made.				•
					•
	-			,	•
· 	_	**	Walaa		
Vision, touch.	Is a proper	Make earth	Voi ce	•	Insecure ground
Are junction box	earth ground	ground attach-	•		attachment,
connector lugs	established.	ment.			:
free of corrosion.					
					:
					•
Vision, touch	Which leveling	Tighten thumb	No specific com-	Safety lanyard must	None likely.
	jack to orient	sorews pro-	munications re-	be connected to ring	
	to - jack 1, 2	vided with	quirement. One	of work cage.	t
	or 3.	level set.	member operation.	<u>-</u>	

SAFETT QUIREMENTS	· PROBABLE EHRORS	JOB AIDS OR TOOLS	NORMAL SILO	VS DEEPER SILO VING V
lanyards	Misjudging light place-			•
d when work-	ment for glare-free			light wattage.
silo on work	illumination at silo			
d attaching	bo t tom.		The state of the s	
	•			
	:			
#.i	Insecure ground			Same
-	attachment,		•• • •	
	•		-	
-	•		a - ve :	
	•		·- - -	
	•			
	Insecure ground			Same
	attachment,			
	:			• • • • • • •
•	·	t	-	
	•	•		
	:			
lanyard must	None likely.	Work Cage		Same
ected to ring	•			
cege.	1			•
				•
A CONTRACTOR OF THE PROPERTY O		C.,	REV SED DATE	
			MSL BASE	ZE 7.1 BUFFORT LEVELING:
		* **		EIN (2 COMPANY DZ-15132

THE BUEING COMPANY

2 21

FUNCTION: A MISSILE BASE SUPPORT LEVELING	PERCEPTUAL REQUIREMENTS	decision requirements
7) Read both level sensors.	Vision, touch,	Determine that
	sound.	esop seusoi prippie
and Annage of Michigan and Control of Michigan Control of the Cont		is centered in the
		sensor scale.
8) (Assuming non-level missile base	Vision, touch	Spring retaining
support.)		plate to be loose.
Use socket wrench to loosen spring		
retaining plate lock bolts, four		
places for each leveling jack.		- -
9) Slide spring retaining plates to-	Vision, touch,	Decide when plate:
ward launch tube wall until they	sound.	touch wall. De-
contact wall. Use socket wrench	4	termine all bolts
to retighten spring retaining		are tight.
plate lock bolts.		
10) Use a wrench to turn each level-	Vision, touch,	Determine when
ing jack drive nut as required	Critical function	both bubbles are
for level sensor bubble positions	or repetition	centered.
until bubbles are centered in	necessary. Poor	
both level sensors.	illumination	
	could affect	
	leveling.	-
11) Use an adjustable wrench to loosen	Vision, touch.	Determination as
spring retaining plate look bolts	If bolts stick	to centering of
(See attached fig. A-4) and slide	avoid excessive	plates in relatic
spring retaining plates away from	force.	to jack. Whether
launch tube wall until plates are		missile has been
centered with respect to jacks.		indexed to target
	entrille against the Commission of Security of States and the Security of Secu	azimuth.



PERCEPTUAL REQUIREMENTS	DECISION REQUIREMENTS	ACTION WORK FORCE	Comminications Requirements	SAVETI REQUIREMENTS	PROPABLE ERRORS
Vision, touch,	Determine that	2nd operator turns	Oral communication	Safety lanyard must be	Sensor bubbles not
sound.	each sensor bubble	jack screws.	retween operator in	connected to ring of .	centered.
	is centered in the		cage and operator	work cage.	4 - •
	sensor scale.		at missile base 20		
_			ft down.		- · · ·
		-			
Vision, touch	Spring retaining	Loosen bolts with	No critical communi-	No critical requirement	Bolts not suffi-
<u> </u>	plate to be loose.	socket wrench.	cation.	unless performed from	ciently loosened.
				work cage.	
				; ;	
·	-			•	- •
Vision, touch,	Decide when plates	Slide spring re-	No critical communi-	No critical requirement	Plates are not
sound.	touch wall. De-	taining plates -	cation.	unless performed from	against wall and
	termine all bolts	tighten plate		work cage.	bolts are not
	are tight.	bolts.		,	properly retight-
		•	•	!	ened.
Vision, touch,	Determine when	Use wrench.	Oral response	Measure jack travel stem	Jack stop could
Critical function	both bubbles are		between operators.	with steel rule and do	fail and cause equ
or repetition	centered.			not allow any jack stem	ment damage that m
necessary. Poor				to extend more than nine	injure personnel.
illumination			•	inches	
could affect					
leveling.					
Vision, touch.	Determination as	Torque required	Voice communi-	Adjustable wrenches are	: 1 :oorly cent ered pl.
If bolts stick	to centering of	to loosen spring	cation between	prone to slip. Care	•
avoid excessive	plates in relation	retaining plate	operators and SIN	should be taken in	1
force.	to jack. Whether	lock bolts.	telephone com-	applying force to avoid	
	missile has been		munication to LCC	skinned knuckles of	F
	indexed to target	•	and equipment	bruised hands or arms.	
	azimuth.		room.		

SAPRTY UIREMENTS	PROBABLE ERRORS	JOB AIDS OR TOOLS	normal silo	VS DEEPER SILO	WING V
lanyard must be	Sensor bubbles not	adjustable wrench.		Distance between	n one operator
ed to ring of	oentered.	2nd operator		and the other	Incressed by
ge.				10 feet to appr	_
• • • • • • •		e e u u man dens man se dens			
			·		
ical requirement	Bolts not suffi-	Socket wrench.			·
performed from	ciently loosened.		<u> </u>		فالمنظرانيسة فالربو
ge.	-				
\					
•	- ·				
- ,	Plates are not	Socket wrench		<u> </u>	
performed from	against wall and				e verse and an
ge.	bolts are not				
t	properly retight-				
i	ened.				مور بند چوندین محمد مداد ورد
jack travel stem	Taok ston oould	Wr enc h		•	s.k.
_	fail and cause equip-	MLANGII	-	a communicate contraction of the	***************************************
el rule and do	ment damage that may			يري فالهامي المستدون	
w any jack stem					
id more than nine .	rulara baraounar.	-			
	-			-	- w - max agentidades
,					
	Hooming combined whates	Adambaha a amawah			
	Poorly centered plates	valuatanta menon	•-	Same	
slip. Care .				-	
e taken in			·		· =
knuckles of					
hands or arms.	•	•		•	
Section of the control of the				·	e to the final was a
			FIGUR	RE 7.1 CON'T:	
		#	· · · · · · · · · · · · · · · · · · ·		D2-15132
		P. D.	THE BA	DEINE COMPANY	P22

	FUNCTION: A MISSILE BASE SUPPORT LEVELING		rceptual Uiriments	DECISION REQUIREMENT		
12)	Loosen thumbscrews and remove	Vision,	touch.	The decision th		
	missile base support level			missile base su		
	set.	_		dead band level		
				was or was not		
				accomplished wa		
		-		made.*		
13)	Place missile base support	Vision,	touch.	None critical.		
	level set in storage case					
	and secure storage case in					
	work cage. Place tools in			_		
	work cage and secure with					
	tielines.					
	·· · · ·					
			-			
· ·						
-						
		AL.				
·						
	•					



*See Function B for Missile Base Support Dead Band Leveling Task Analysi

near eanning of

•					
PERCEPTUAL REQUIREMENTS	DECISION REQUIREMENTS	ACTION WORK MORCE	COMMUNICATIONS REQUIREMENTS	SAPETT REQUIREMENTS	PROBABLE ERROR
Vision, touch.	The decision that missile base support dead band leveling was or was not to be		Oral communication to 2nd operator at silo base.	Safety langard attached to work cage ring.	Mone
	accomplished was		er e e		
Vision, touch.	None critical.	Manually secure	None critical.	All tools and equipment to be transported in work cage must be properly secured in work cage.	herage to missile and equipment or injury to personn may result from a falling object.

SAPETT EQUIREMENTS	PROBABLE ERRORS	JOB AIDS OR TO)OLS	MORMAL SILO	78	AND MILE	VIII V
langard attached	Mone	Work Cage.	-			ased communication of the property of the prop	
			·		 		
ols and equip-	Demage to missile	Hedown straps.			 Same.		··· - · · · · · · · · · · · · · · · · ·
to be transported it cage must be by secured in age.	and equipment or injury to personnel may result from a falling object.				 	-	
	retting calent						

3

THE BUEING COMPANY P23

port as described in Function A.	As described in Function A. Vision, touch.	As described in Function A. Verify bubble motion.
2) Use adjustable wrench to turn No. 1 jackscrew clockwise until bubble motion is noted on one		Verify bubble
No. 1 jacksorew clockwise until bubble motion is noted on one	Vision, touch.	
bubble motion is noted on one		motion.
of the level sensors.		
3) Use adjustable wrench to turn		
jack No. 1 jackscrew clock-	the state of the s	
wise until a change of two		· ••• · ••• · · · · · · · · · · · · · ·
minutes of are (approximately		
2/3 of a gradient mark) from		Interpretation
this initial bubble position		minutes of arc
is noted.	Vision, touch,	relation to gr
	ability to write	ient marks. C
4) Use adjustable wrench to turn	legible numbers.	correlation in
No. 1 jacksorew counter-clock-		inter-operator
wise and count the number of		derstanding of
turns required to return the		wrench turns v
the level sensor bubble to		sus bubble rea
the initial bubble position		
as noted in step (2). Record		<u> </u>
the number of turns.		•



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*HOTE: Verify that missile skirt umbilical cable connection procedures autonavigator umbilical have been performed before proceeding wibase support.

missile support suspension and alig

***NOTE: If bubble motion is noted in both level sensors, select the leve that indicates the greatest motion. Record bubble position.

UPPORT	PERCEPTUAL REQUIREMENTS	DECISION REQUIREMENTS W	ACTION ORK FORCE	COMMUNICATIONS REQUIREMENTS	SAFETY REQUIREMENTS	PROBABLE ERRO
ip-	As described in	As described in As	described in	As described in	As described in Func-	As described in
A.	Function A.	Punction A. Fu	nction A.	Function A.	tion A.	Punction A.
	Vision, touch.	Verify bubble Vi	sual and man-	Oral communication	Safety lanyard operator	Not detecting
1		motion. us.	1.	between operators.	in work cage.	bubble motion.
			•			
			-			
		.	-	-		-
 						
 						•
H			•	+	· ·	
+		Interpretation of 70	-ft. lb. of			D
-	•	minutes of arc in to				Poor readings. Improper corre-
··· J.	Vision, touch,	•	a close envi-	Cral, between	Safety lanyard in	lation between
T	ability to write	ient marks. Close ro		operators.	vork cage.	what operators
	legible numbers.	• •	ersedwith oral	•	,	understand and
$T_{}$		inter-operator un- con	mmmication and		1	subsequent
		derstanding of a	decision making			гевропае.
	. ,	wrench turns ver- re-	quirement.			
. }		sus bubble readings.	-			
7						
					•	
<u> </u>				,		_

If the number of turns recorded in B-3 exceeds 14 turns, suspend post emplacement operations. The missile support suspension and alignment system will require maintenance and possible missile removal.

umbilical cable connection procedures and procedures for connecting ave been performed before proceeding with dead band leveling missile



in both level sensors, select the level sensor bubble DATA SHEET

SAFETY ULREMENTS	PROBABLE ERRORS	JOB AIDS OR TOOLS	NORMAL SILO	VS DEEPER S	ITO MING A
cribed in Func-	As described in .	As described in Punc-			
	Punction A.	tion A.			
· · · · · · · · · · · · · · · · · · ·					
lanyard operator	Not detecting	Wrench.	-		may be decreased.
k cage.	bubble motion.		· · · · · · · · · · · · · · · · · · ·		ation more diffi-
	- · ·	At the second se	· · · · · · · · · · · · · · · · · · ·		g on noise level
		**			ental supply duct
:	-				bove operators
.				head at sile	base.
	•				
•		- 40 400 40			and the state of t
•				·	
:	Poor readings.	Wrench, penoil, note-		No.	•
	Improper corre-	book. Skill in read-			. 1
lanyard in	lation between	ing sensor bubble			
98. <u>6</u> 8°	what operators	and communicating in-			
Ť	understand and	formation to another			
	subsequent	operator for action.		The second secon	* •
	response.				
. 4	1	-			
-					
•					
-	-				
· · ·				· ·- · · · · · · · · · · · · · · · · ·	
· · · · · · · · · · · · · · · · · · ·		-			
ons. The					
sile removal.					
i		,			
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1			•••		
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		T REVI			
			FIGUI	ZE 7.2 CON'	T ————————————————————————————————————
				BAND LEVE	
		Appril	THE #	DEING COMP	PANY PRY

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!	FIGURE 7.2 CONT.	CAIC CAIC DATE
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		· · · · · · · · · · · · · · · · ·
	9maC	ered. Wrench
		anpae-
• Jeun	fatigue may result so	noise. exotore
	equate at deeper leve	eq; ox
	on at noitentally IX	tot de- Wrench, level set,
		screw driver
	9#BS	driver Applicable screw-
		-
	Smac	slou- Wranch
] *		1
1 1	*	
	эме	sicu- Pencil, log book
Α .	SILO VE DERPERSILO WING	TAMBON STOOL BO STILL BOL S

FUNCTION: B DEAD BAND LEVELING MISSILE BASE SUPPORT	PERCEPTUAL REQUIREMENTS	DECISION REQUIREMENTS
5) Divide the number of recorded	Vision	Information re-
turns by 2 and subtract 1.		_quired from leg
		book.
6) Turn jack No. 1 jackscrew		
clockwise the number of turns		-
calculated in Function B-5.		
7) Tighten No. 1 leveling jack		
drive nut set acrew.		proper sores se
		ting forces.
8) Repeat steps B-2 through B-7	Vision, touch	Same as Functio
for jack No. 2.		B-3 and B-4 plu
	<u> </u>	information re-
9) Repeat steps B-2 through B-7		quired from log
for jack No. 3.	_ 	book
O) Use wrench to loosen spring	Touch, vision,	Stress condition
retaining plate look bolts	•	brought on by 1
and slide arring retaining	•	tigue from wren
-	tered.	operation in a
wall until plates are centered	•	base could affe
		decision that
		plates vere ce
		tered with resp
		to leveling ja



RT	PERCEPTUAL REQUIREMENTS	DECISION REQUIREMENTS	ACTION WORK FORCE	COMMUNICATIONS REQUIREMENTS	SAPPITY REQUIREMENTS	PROBABLE ERRORS
	Vision	Information re-	Mathematical cal-	No critical com-	Wear protective head	Brror in turn calc
	and the second s	quired from log	culation.	munications if notes	gear at all times when	lation.
		book.		are not in doubt.	working in silo. (Wear	and the second s
			.	ي ريست سند د	and attach safety lan-	
	and the same of th		. .		yard when in work cage).	
	Vision, touch	Information re-	Mathematical cal-		and a company of the second of	Error in turn calc
		quired from log	culation			lation.
		book		-		
	Vision, touch	Decision as to	Tighten set screw		•	Improper screw dri
		proper sores set-			. 🗚	head can cause scr
		ting forces.				head damage.
	- 					•
	Vision, touch	Same as Function	Environmental con-			Bubble notion not
	Lanara, water	B-3 and B-4 plus	ditions and fatigue			tected, poor readi
		information re-	will effect operator			improper correlati
		quired from log	potential. Time re-	-		between what opera
		book.	quirements will ex-		-· · · - ·	understand and sul
	··· -	Inchia.	ceed preceeding			quent response.
		•	operations due to		€ -	. – . .
			operator fatigue.		•	-
			oborn tot sample			_
	morrale and at an	Stress conditions	Samo an Banation			Plates not center
	Touch, vision.	brought on by fa-			•	
	Critical that	tigue from wrench		-		-
	plates be cen-	operation in silo	*			
- .	tered.					
		base could affect	wartractel.		†	
		decision that			,	
		plates were cene		-		
		tered with respec			•	
		to leveling jacks	•			
						-

POTT REMENTS	PROBABLE ERRORS	JOB AIDS OR TOOLS	NORMAL BILO	vs imper silo wing v
otective head	Beror in turn calcu-	Pencil, log book		Same
; all times when	lation.	Person i make majurajan majarah ju jumpan majarah ka		,
in silo. (Wear		· · · · · · · · · · · · · · · · · · ·	The state of the s	
ach safety lan-			a v - a sumbalanda da verso qualant. e specie e su quanti	
ien in work cage).				
	Error in turn calcu-	Wrench		Same
	lation.	A RANGE TO U.S. T.	— A was AALES a water a finite water was	
<u>.</u>		-	and as the analysis are to the the distributions	
•	Daproper screw driver	Applicable screw-		Same
<u>.</u>	head can cause screw	driver		
	head damage.	_		
	100			
	Bubble motion not de-	Wrench, level set,		If illumination is not ad-
	tected, poor readings,	pencil, log book		equate at deeper level operator
	improper correlation			fatigue may result sooner.
	between what operators			
	understand and subse-			
	quent response.			
·				
	Plates not centered.	Wrench		Same
_	•			
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***************************************		Calc	REVISED DATE	URE 7.2 CON'T

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THE BOEING COMPANY
SEATUR 24 WASHINGTON

	nction B: Ad band Leveling Missile Base support		REPTUAL REMENTS		DECISION REQUIREMENTS	
11)	Use wrench to tighten spring re-	Vision.	touch. Do	Determine	prop	
	taining plate look bolts.	not over			4	
					·	
	<u> </u>					
					_	
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TASK ANALYSES OF OPERATIONS ASSOCIATED WITH A 10-FT DEEPER SILO - WING V

ORT	PERCEPTUAL REQUIREMENTS	DECISION REQUIREMENTS	ACT WORK	TION FORCE	COMMUNICA REQUIREM	TTONS ENTS	SAPETY REQUIREMENT	rs	PROBABLE	ERRORS
	Vision, touch. D	o Determine proper	Tighten	holts to	No critical	communi-	Wear protection	re head	Loose belts	le .
1	not over tighten.	tightness.	proper t	torque.	cations.		grar.		·	
			-		*				.	
		· · · · · · · · · · · · · · · · · · ·				-			,	=-
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APRIY REMENTS	PROBABLE ERRORS	JOB AIDS OR TOOLS	NORMAL SILO	V8 DEEPER SILO WING V
tentive head	Loose bolts.	Mrench		
		THE MARK AT A COLUMN TO THE PARTY OF THE PAR		
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tra .	•	REVISED	DATE	FIGURE 7.2 CONT.	·
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Appr Appr	 			THE BOEING COMPANY SEATTLE 24 WASHINGTON	P26

8	FUNCTION: C SUMP PUMP REMOVAL, INSTALLATION AND MAINTENANCE	PERCEPTUAL REQUIREMENTS	DECISION RECUIREMENT	
1)	Three members assemble work cage.	*		
2)	Place vapor proof flood lamps in			
	work area on second level and se-	·		
		• • • • • • • • • • • • • • • • • • •		
	launch tube area.**			
3)	Enter elevator work cage and de-			
	scend to missile base.*			
4)	Remove sump cover plate by re-	Visign, touch; if	Where to move t	
	moving hold down mute, attaching	bolts stick, avoid	sump cover plat	
	5/8 inch eyebolt, positioning	excessive force.	where to attach	
	work cage over sump, attach rope	·	rope to work ca	
	to cage and eyebolt, and move			
	work cage with cover to one side,			
<u>.</u>	lower to floor and detach rope.	-		
5)	Remove water from sump by using		Whether it is :	
	hand pump to transfer water from		quired to pump	
	sump to containers		any excess of	
	·	determinent to the format of the second of t	where to transi	
			the water.	
		·- · · · · · · ·		
6)	Remove pumping unit by unholt-	Vision, touch; if	To determine ti	
	ing and removing over support	bolts stick, avoid	sumo pumo is m	
	beam from sump, disconnect pump			
	discharge piping, disconnect pump		_	
	power cable at J-Box, and remove			
	pump base hold does muts			



^{*} See detailed task analysis for work cage, page 33

3-40 1 4710 FF. . . A2

^{**} See detailed task analysis for flood lamps, item 2, page 21

PERCEPTUAL REQUIREMENTS	DECISION REQUIREMENTS	ACTION WORK * FORCE	Communications Requirements	SAPETT REQUIREMENTS	PROBABLE ERROR
		- y · · · · ·			
Vision, touch; if	Where to move the	Torque required	Voice communication	Very easy to drop the	Riectrical pump (
bolts stick, avoid		to loosen bolts	between operators;	sump cover if not pro-	left on - cever i
excessive force.	where to attach	and attach eye-	and SIM telephone	perly tied to work cage-	atick to sump and
	rope to work cage.	bolt.	communication to LCC	cover weight 125 lbs.	age may result to
***************************************	-		equipment room for	Electrical power re-	eleaston nong osi
		- ·	emergency only.	moved from pump.	while pulling it
	- .				1
Vision	Whether it is re-	Pumping of hand	Voice communication	Slipping on wet mile	:
•.	quired to pump out	yunp.	between operators;	floors Bleetries power	1
· manager ex	any excess of water		and SIN telphone	removed from pump.	
	where to transfer		communication to LCC	- u -	. •
	the water.		aquipment room for		
	- –		energency only.	-	
			9		
Vision, tough; if	To determine that	Torque required	Toise communication	<u>-</u>	
bolts stick, avoid	sump pump is mal-	to loosen bolts	between operators;		1.
expessive force.	functioning.	and nuts.	and SIN telephone		
		-	communication to LCC		
			equipment room for		
		•	emergency only.		,
	_				

coago, pago 33

od lamps, 1tem 2, page 21



SAPERT TRESCENS	PRODABLE ERRORS	JOB AIDS OR TOOLS	LAMHOK	SILO	V 8	DEEPER SILO VI	IG Y
<u> </u>	era sama samasa ya en						
paganing time							
	•						
	and the second second						
	*	ها، نشان داندرونشدان و المدر المطب المسادات	· ·				
	-						
	•	mlama al miliona					
•	Klectrical pump cover	541X0 and/or 564X0					
	left on - cover may	wrench or crows foot					
_	stick to sump and dam-	rope, 5/8 inch eye					
-	ege may result to	bolt, work oage					
_	elevator work cage						
ZOW DIMP.	while pulling it loose.		-				
<u>.</u>	•	<u>-</u> .		. <u> </u>			
and the second second second	1.	54110 and 56410 hand			Same		
g on vet sile Electrical pover	:	pump, containers for					
from pump.	•	water (30 gal. drim	-				
r vestur familie	ì	or like item).					
		MA AAAA AAAAAA		<u> </u>			
·		•	•				
		·					
		541.00 or 564.00					
	1	wrench or growsfeet	-				
	••	,					
		-					
		-		~ ~~~~~~~~~~			
		CHIC	ED DATE	 :		~~ ~	
		Cov	-			7.3 LING & MAINT	
		Appr	+ - + -			COMPANY	D2-15132
				SEA	TLE 24, WASHIN	ICTON	P27

S	UNCTION: C RIMP PUMP REMOVAL, DISTALLATION AND MAINTENANCE	PERCEPTUAL REQUIREMENTS	DECISION REQUIREMENTS
7)	Lift sump pump from sump by attach-	Vision, touch; if	Where to move
	ing a rope to the lifting lugs on	bolts stick avoid	pump to prior
	the motor and to the elevator work	excessive force.	lifting into w
	cage; lift and lower to floor and		cage and vice
	detach rope; remove holddown nuts	_	Veres.
	at motor base and detach motor from		
	pump; place motor and pump on work		
	cage platform and raise to equip-		
	ment room level; hand carry motor		
	and pump to access shaft and re-		
	assemble to facilitate handling;	the second-form country of the count	
	raise pumping unit to surface using		•
	truck hoist; lower replacement pump		
	and motor to equipment room level;		
	detach motor from pump and hand		
	carry pump and motor to work cage;	_ , _	-
	lower to sump floor and reassemble		•
	pumping unit; then attach rope to		
	motor lift lugs and to work cage and		
	lower pumping unit into sump using		
	work cage as hoist.		
8)	The rest of the procedure for in-		_
	stallation of the pump is just the		4 .
	reverse of steps 6, 5, and 4 (Punc-		
	tion C).		
	and the second s		
		<u>.</u>	



*See attached illustration of sump pump removal operation.

TASK AMALYSES OF OPERATIONS ASSOCIATED WITH A 10-FT DEEPER SILO - WING V

PERCEPTUAL REQUIREMENTS	DECISION REQUIEMENTS	ACTION WORK FORCE	Communications Requirements	SATEST REQUIRE IS 128	PROBABLE EURORS
- Visien, touch; if bolts stick avoid	Where to move the pump to prior to	forque required to loosen bolts, lift-		Very easy to drop the pump if not properly	Pump may stick to s
emessive force.	lifting into work	motor and pump to	sIN telephone com- munication to LCC	Pump weighs 117 lbs.,	to elevater work as
	versa.	and from the work	equipment room for	motor above weighs	bese.
D		cage and to hoist	emergency only.	85 lbs.	
		in access shaft.			
		•			:
				_,	· · · ·
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8	=	-		-	•
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p removal operation.



SAPETY TREMENTS	PROBABLE ETRORS	JOB AIDS OR TOOLS	NORMAL SILO	7 8	DESPER SILO WING V
sy to drop the	Pump may stick to su	p 541.00 and/or 564.00		Sa	De
not properly	and damage may result	wrench, mechanical			
work cage.	to elevater work cag	maintenance truck,			
ighs 117 lbs.,	assembly in pulling	it rope, work cage.			
	. basa.				
·		A	a an market was anomalism on the date of the		
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		C17 REVISE	D DATE		
		tro	FIG	GURE 7	3 CONT

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P 28

THE BUEING COMPANY
SEATTLE 21 WASHINGTON

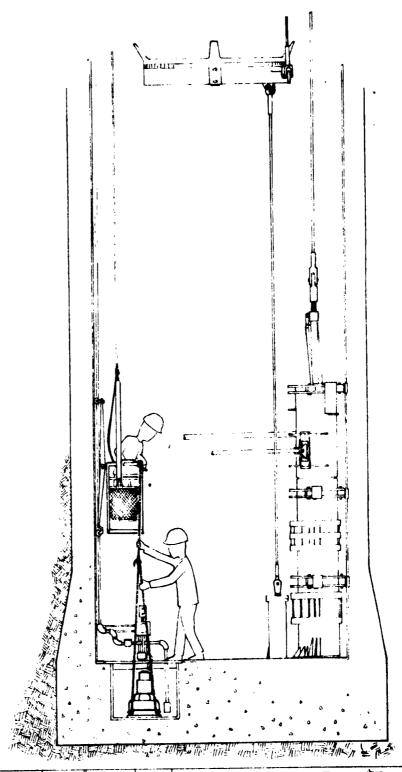
SUM	C'IION: C P PUIP REMOVAL, TALLATION & MAINTENANCE	Perceptual Requirements	DECISION REQUIREMENTS
9)	Checkout the pump by returning the	Vision: to see	To determine
	water from temporary storage to the	that enough water	water quanti
	sump; activate START-STOP switch	is available and	is sufficien
	if quantity of water is not suffi-	is check that	actuate floa
	cient to actuate float switch; ob-	water is removed	switch.
	serve that pump removes water from	from sump.	
	sump and place control switch in		
	AUTO position.		
10)	If it is determined that the mal-	Vision, touch:	To determine
	function is in the check valve,	the check valve	function is.
	then steps 4 through 9 (Function	may be stuck by	the check va
	C) may be eliminated; turn HAND-	corrosion to its	
	OFF-AUTO switch for pump to OFF	connecting pipes.	
	position and remove check valve		• • •
	using common hand tools.		
11)	Install a new valve immediately	Vision, touch:	
	using common hand tools, set	the check valve	
	HAND-OFF-AUTO to AUTO position.	s hould hot be	
		over torqued.	
		· · · · · · · · · · · · · · · · · · ·	
12)	If it is determined that the	Vision	To determine
	liquid level float switch is mal-		malfunction :
	functioning then steps 4 through		float switch
	11 (Function C) may be eliminated;		-
	place circuit breaker for pump to		
	OFF position, disconnect electri-		
	cal wire to switch, remove hard-		
	ware holding switch in place and		•
	remove switch.	-	



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<u>,</u>					and the second s
MENA IICE	PERCEPTUAL REQUIREMENTS	DECISION REQUIREMENTS	ACTION WORK FORCE	Communications Requirements	SAFETT REQUIREMENTS
mp by returning the	Vision: to see	To determine if		Voice communication	Avoid spilling water
rary storage to the	that enough water	water quantity		between operators;	on floor of silo.
START-STOP switch	is available and	is sufficient to		SIN telephone com-	
water is not suffi-	is check that	actuate float		munication to LCC	
e float switch; ob-	water is removed	switch.		equipment room for	
removes water from	from sump.			emergency only.	
control switch in			· - · · · ·		
					· · · · · · · · · · · · · · · · · · ·
nined that the mal-	Vision, touch:	To determine mal-	Torque required		
the check valve,	the check valve	function is in	to loosen check		-
rough 9 (Function	may be stuck by	the check valve.	valve from ad-		
nated; turn HAND-	corrosion to its		jacent fittings.		
for pump to OFF	connecting pipes.				=
move check valve			•		
ind tools.					
valve immediately	Vision, touch:		Torque required	- -	
and tools, set	the check valve		to tighten valve	• <u>-</u>	•
to AUTO position.	s hould not be		in place.		
	over torqued.				•
mined that the	Vision	To determine if			Insure circuit breaker
loat switch is mal-		malfunction is in			is in OFF position.
en steps 4 through		float switch.			
) may be eliminated;					
breaker for pump to					
disconnect electri-			•		
itch, remove hard-					
witch in place and					

FF position. in AUTO position. REVISED DATE FIGURE 7.3 CONT CH. AUTO POSITION.	Safety Irements	PROBABLE ERROR	JOB AIDS OR TOOLS	NORMAL	SILO	vs	THEFTER SYLO W	TRG A
HAND-OFF-ACTO switch may not be turned to GFF position. Same. Same. Hand-OFF-ACTO switch may not be turned to GFF position. Same. Same. Hirolit breaker Circuit breaker loft FF position. in AUTO position. Head Same To Same T	illing water		1X0 and/or 564X0			Sem		
HAND-OFF-AUT switch May not be turned to OFF position. Same.								
HAND-OFF-AUTU switch May not be turned to OFF position. Same Frout breaker Circuit breaker left in AUTO position. Same Same Same Same Same Same Same Frout breaker Circuit breaker left in AUTO position.								
HAND-OPP-10Te switch may not be turned to GFF position. Same. S				<u></u>				
HAND-OFF-HUTE switch Bay not be turned to GFF position. Same. Same. Same. Same. Same. Figure 7.3 Cont.	· · · · · · · · · · · · · · · · · · ·							
HAND-OFF-AUTU switch May not be turned to SEE position. Same S								The second secon
HAND-OFF-AUTU switch may not be turned to GFF position. Same S						anna a nga anganan an mana nika sang na mana nika nika nika nika nika nika nika n		
Easy not be turned to GFF position. Same. FF position. in AUTO position. FIGURE 7.3 CONT PAGE 1122			· · · · · · · · ·					
Easy not be turned to GFF position. Same. FF position. in AUTO position. FIGURE 7.3 CONT PAGE 1122								
gircuit breaker Circuit breaker loft Prosition. in AUTO position. Same Same Same Figure 7.3 CONT FIGURE 7.3 CONT PROBLEME COMPANY Parising Company								
pricuit breaker Circuit breaker left FF position. in AUTO position. Same 177910 DAN FIGURE 7.3 CONT.		-						
ofrcuit breaker Circuit breaker loft FF position. in AUTO position. Same Same FIGURE 7.3 CONT THE BUILDING COMPANY D2-15/22	-	OFF position.						
circuit breaker Circuit breaker left Fr position. in AUTO position. Same Same Same Fr position. in AUTO position.								
pircuit breaker Circuit breaker left FF position. in AUTO position. Same Same Same FF position. In AUTO position.			4			.		
pircuit breaker Circuit breaker left FF position. in AUTO position. Same Same Same FF position. In AUTO position.				-			-	
pircuit breaker Circuit breaker left FF position. in AUTO position. Same Same Same FF position. In AUTO position.				=				
pircuit breaker Circuit breaker left FF position. in AUTO position. Same Same Same FF position. In AUTO position.				-		Som		
FF position. in AUTO position. REVISED DATE FIGURE 7.3 CONT CONT. THE BURE COMPANY D2-15122								
FF position. in AUTO position. REVISED DATE FIGURE 7.3 CONT CONT. THE BURE COMPANY D2-15122	•			-				
FF position. in AUTO position. REVISED DATE FIGURE 7.3 CONT CONT. THE BURE COMPANY D2-15122	•			-	- •			
FF position. in AUTO position. REVISED DATE FIGURE 7.3 CONT CONT. THE BURE COMPANY D2-15122								
FF position. in AUTO position. REVISED DATE FIGURE 7.3 CONT CONT. THE BURE COMPANY D2-15122	-		• •			· · · · · · · · · · · · · · · · · · ·		
FF position. in AUTO position. REVISED DATE FIGURE 7.3 CONT CONT				_		a m ++		
FF position. in AUTO position. REVISED DATE FIGURE 7.3 CONT CONT. THE BURE COMPANY D2=15122	circuit breaker	Circuit breaker left				Sam	e	
REVISED DATE FIGURE 7.3 CONT	•	* * * * * * * * * * * * * * * * * * * *		-				
FIGURE 7.3 CONT	• • • • • • • • • • • • • • • • • • •	-						
FIGURE 7.3 CONT		-			-		<u>-</u>	
FIGURE 7.3 CONT								-
FIGURE 7.3 CONT						٠	-	
FIGURE 7.3 CONT								
FIGURE 7.3 CONT								
FIGURE 7.3 CONT	,		11					
CHE ROEING COMPANY DZ-15122			C. R	EVISED DATE	FK	URE 7	13 CONT	
			c+x =		• •		· · · · · · · · · · · · · · · · · · ·	
SEATTLE 21 WASHINGTON P 29			Apr		THE #	OEIN	COMPANY	P 29



CALC	REVISED	DATE	FIGURE 7.3 CONT. SUMP PUMP REMOVAL OR INSTALATION	GER
APR			MINISTER CYSTEE F	02-15132
APR	- ·		THE BOEING COMPANY	PAGE 30

FUNCTION: C SUMP FUMP REMOVAL, INSTALLATION & MAINTENANCE	PERCEPTUAL REQUIREMENTS	DECISION REQUIREMENTS
13) Position and attach a new float	Vision	
switch immediately after the re-		
moval of the defective switch;		
connect electrical wire to switch,		a
return HAND-OFF-AUTO switch to AUT	9	
position.		·· · · ·
14) Check out float switch by hand		
operation to determine if pump		- 4.
starts at high level and stops	remandant remandant	
at low level.		
15) Prior to removal and replacement	Vision, inspec-	Determination (
of various sump pump components	tion for leaks.	fault by isola-
fault isolation must taken place		tion of compon-
for a flooded sump condition by		ents.
using START-STOP switch to de-	-	
termine that pump operates; check		
for electrical continuity across		
START-STOP switch; check for mal-		
function in motor starter; de-		
termine that water in sump is		-
discharged when pump operates; see	who is an	
that check valves are open; check	*	
flexable hose on discharge line	-	
for leaks; check for electrical	·	
ecutionity across HAND-OFF-AUTO		
entral switch; check for malfunc-		-
tion in high level relay switch.		
	-	



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TASK AHALYSES OF OPERATIONS ASSOCIATED WITH 10-FOOT DEEPER SILG - WING V

PERCEPTUAL REQUIREMENTS	Decision Requirements	ACTION WORK FORCE	COMMUNICATIONS REQUIREMENTS	SAPETY REQUIREMENTS	PROBABLE ERRORS
Vision			Voice communication		· · · · · · · · · · · · · · · · · · ·
			between operators;		
	- · - · · ·		SIM telephone com-		
k			munication to LCC		• • •
10			. aquipment room for		
			emergency only.		i salas e i se e
<u>Vision</u>			a		
			u		
	-		• • • • •		• · · · · · · · · · · · · · · · · · · ·
		••	• • •• =		
			, <u>-</u> , <u>-</u> , .		•
			ساه میکنده در و در در		
Tidon france	Dohamata atta a a			•	
Vision, inspec-	Determination of		•	Avoid standing in damp	Insuring that all
tion for leaks.	fault by isola-			areas of missile floor	valves are open, n
	tion of compon-			while making electrical	seeing leaky condi
	ents.			teats.	•
*		- ,	-		•
		•	•		
<u> </u>	-				

PRY RECEITS	PROBABLE ERRORS	JOB AIDS OR TOOLS	NORMAL SILO	VS DERPER S	SILO WING V
		54110, electric lan-			
		tern			
	• · · · · · · · · · · · · · · · · · · ·			and the second control of the contro	
			and the second s	و در الله الله الله الله الله الله الله الل	
·· *c		541XO, electric lan-		Comp	
				Sene	
=		tern			
	per	•			
			· - · · · · · · · · · · · · · · · · · ·		
			≠ ••		•
	Insuring that all check	542X0 or 541X0,	-		- <u></u>
ding in damp	valves are open, not	liquid level in-		Same	• •
issile floor	seeing leaky condition.				
ng electrical	search countrious	dicator, multi- meter, electric	<u>.</u>		
	•	lantern.	-		
		Lantern.	•	and the second s	N. The street sales from the Automotive section of the sales of the sa
		•			
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		trac :	FIGUR	RE 7.3 CON'	r
		CNK			102-15132
		Appr	THE B	DEING COMPA	NY =31

	Tion: C Supp Pump removal Allation & Maintenance	PERCEPTUAL REQUIREMENTS	DECISION REQUIREMENTS
16)	Component fault isolation for a	Vision	Determination of
	lew water level condition in the		
	sump should be accomplished by		
	manually actuating the float		
	switch, and testing the high level		
	probe for a short circuit resulting		
	in false high level indication		
17)	As a result of fult isolation the	Vision, touch	
	various items such as the sump	- · · · · · · · · · · · · · · · · · · ·	
	pump discharge hose, high level		
	alarm probe, START-STOP switch,	- 40	
	meter starter relay, HAND-OFF-AUTO		•
	control switch, and the high level		
	alarm relay must be removed, re-		
	paired and/or replaced (as well as		
 -	the previously mentioned pump.		
·	chack valve, and float switch).		
18)	Following repair check out must be	Vis ion	*
	accomplished on all items repaired		
	(with the exception of the flexible		
	hoses) by seeing that no high level		•
	alarm signal is generated unless		`
	water in sump is at high level;		•
	checking that START-STOP switch		
	operates pump; checking that motor s	tarts	
	when HAND-OFF-AUTO switch operates	-	
	properly; simulating high level in		
	sump by applying jumper across ter-	·	
	minals of high level probe to see		
	that pump should start and high level	L	
	alarm shoudl come on.		



TASK ANALYSES OF OPERATIONS ASSOCIATED WITH 10-FOOT DEEPER SILO - WING V

PERCEPTUAL REQUIREMENTS	DECISION REQUIREMENTS	ACTION WORK (FORCE	Communications Requirements	Safett Requirements	PROBABLE ERROR
Vision	Determination of		Voice communication	Avoid standing in damp	
			between operators;	areas of missile floor	
	tion of compon-		SIN telephone com-	. While making electrical	·
	ents.		munication to LCC	tests.	
			equipment room for	and the contract that the contract of	ن برسید
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	un nincasamente formanisti —		* * * * * * * * * * * * * * * * * * * *		1
Vision, touch				and the second of the second o	•
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· ·		ponents			. trical components
)		-	equipment room for		
			margency only.	-	
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		-			
					-
771 - 9			.		
Vis ion			Voice communication	•	
			between operators;		
le .			SIN telephone com-		
-			munication to LCC		,
			equipment room for		
			emeraench ourla.	-	
starts				•	
e de la companya de La companya de la co					•
		•	•	-	
·					•
				,	
				,	



AFET IREMENTS	PROBABLE ENRORS	JOB ANDS OR TOOLS	NORMAL SILO	VS DEEP	MR SILO WING Y
unding in damp		542X0 or 547X0		Some	
missile floor		miltimeter			
ting electrical					
' '					
					•
:					
	Restrical power	<u> </u>			
	must be off during				
ية فيند بيدي مديند يومند دد	replacement of elec-				
	trical components.				M
					* · · · · · · · · · · · · · · · · · · ·
			• •	,	
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		•			
-				Same	
		raction to desire on other con-			
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			-	TT A ALL A MALE AND ALL AND MALE AT A MALE	
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			•	TO A SECURITY OF THE PARTY OF T	
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		REVISE	FIGI	JRE 7.3 CC	PRIT.
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FUNCTION: D WORK CAGE UTILIZATION AT SILO BASE (LAUNCH TUBE BASE)	PERCEPTUAL REQUIREMENTS	decision requirements
This procedure requires three (3)		
personnel - one in equipment room,		
two in work cage.		
1) Identical to those of step (1) of Function "A".		- · · · · · · · · · · · · · · · · · · ·
2) Identical to those of step (2) of Function "A".		
3) Place tool kit in work cage. Ele- vator work cage will be lowered	Visual, tactual	Estimates requir
and positioned adjacent to, e.g.,		traverse distan
azimuth drive motor and first stage	•	mreserate erosem
gear reduction. Utilize work cage		-
control pendant (P/N 25-18099-1 or	TOTAL ACTOR - THE PARTY OF THE	
P/W 25-18099-2):		• •
a) Depress DOWN-RIGHT switch. Set		- · ·
cage on silo floor.		-
b) Depress TRAVERSE and DOWN-RIGHT switches.		-
4) Wings I through V require two per-	Visual, tactual	Equipment room
sennel in work cage. Man #1 leaves	J	personnel: esti-
work cage for floor of sile. Hen	<u> </u>	mate required or
remains in work cage.		adequacy of sli
		application; ac-
		oursey of sling
الرابي المستنفسان		to hoist attach
· · · · · · · · · · · · · · · · · ·		ment; speed of
		learning.



Procedures for entering work cage, precautions to be ebserved, detailed in It is anticipated that no maintenance will be required on this unit up to 4 If maintenance should be required beyond the motor and first stage reduction including base support ring will require removal. (This would necessitate The weight of this combined unit (Azimuth drive motor, first and downstage 1934-1962) base support ring) is 7000 pounds, and would require a crume 1

Perceptual Requirements	decision Requir ement s	ACTION WORK , FORCE	COMMUNICATIONS REQUIREMENTS	SAFETY REQUIREMENTS	PROBABLE ERRORS
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				war war a same	
	<u>-</u> . –				
					
	and the second s				
	- / - /		· · · · · · · · · · · · · · · · · · ·	· - -	
Visual, tactual	Retimates required	Digital pres-	Communication may be	-	Over/under estimate
	for vertical and	sure: minimal	required with per-		of vertical/travers
	traverse distances.		sonnel in equipment		, diatanse; press wr
	•		room (voice), or via		button. Failure to
. 👍			telephone with main-		utilize safety lan-
			tenance support ve-		yard. Failure to
	-		hicle, SM8OA, SM8OB.	-	take tool kit,
	-				
		•	•		,
-					
	• •		_		
Visual, tactual_	Equipment room	Attachment of	With equipment room	Accuracy in attach-	Slipping or falling
	personnel: esti-	sling to ladder;	(voice)	ment of package to	off ladder through
	mate required of	attachment of		sling and hoist.	ermer in attachmen
	adequacy of sling	package to hoist		. Safety belt for use	of sling or hoist.
	application; ac-	operation of		on ladder.	Pailure to utilize
	ourney of sling	hoist.			safety belt.
	to hoist attach-				
	next; speed of				
	lovering.				

^{***}Step 4 and 5A apply to Wings I through
V, regular sile; step 5B applies to
Wing V deeper sile only.



recautions to be observed, detailed in 7.0. SMBOA-2-10 will be required on this unit up to a period of three years. you the motor and first stage reduction gear, the complete unit, aire remeval. (This would necessitate removal of the minaile limith drive motor, first and downstage gear reduction, 200 pounds, and would require a crane for removal.

JETY IREMUNTS	PROBABLE ERRORS	JOB AIDS OR TOOLS	NORMAL SILO	VS DEEPER SILO	WING T
		and the second of the second s			
				and a decimal of the commentation of the decimal of the conficulty of the confiction	
	: -				
	. .				
	·				
	, -				
-	Over/under astimate	Standard tool kit	Ability to estimate		
	. of vertical/traverse	for work cage. for-	spatial relationships.	_	
F	distance; press wrong	que wrench may be		Power and communion	
•	button. Failure to	required: informs-	· -	mat have some req	pirment for
	utilize safety lan-	tion not available.		additional length	
	yard. Failure to		· · · · · · · · · · · · · · · · · · ·		
	take tool kit.	. •		Example	
•	•	•			
	· ·			na sandare har he is a negadamba nahar ing	Same and the same of the same
			and a section of the section of	<i>L</i>	ر بميموم
soy in attach-	Slipping or falling	Hoist, sling, tag-	Consientious observance	<u> </u>	
of package to	off ladder through	ling, safety belt.	of task requirements.		
and hoist.	ermer in attachment				
y belt for use	of sling or hoist.				
dder	Pailure to utilize				
	şafety belt.				
				4	
		•			
,	t				l
		C REV	1ED DATE	_	
Wings I through			FIGUR		
A. Chirms and		Chr	WORK CAGE		02-15132
		Appr	THE BUS	EING COMPANY :	P 33

PUNCTION: D ORK CAGE UTILIZATION AT SILO BASE (LAUNCH TUBE BASE)	PERCEPTU REQUIREME		SION ENCENTS
(A) Where azimuth drive motor requires	Visual, tac	tual Placemen	t of la
removal, procedure would require		der for	mrimm
two men as follows: Man #1 - position	a	efficien	oy duri
12-foot ladder under motor. Wear		operatio	n. De-
safety belt on mounting ladder.	anger er ager generates son and	temine	aligume
Man #2 - depress UP-LEFT switch and		Determin	e adequ
ascend approximately 30 feet. De-		of sling	fasten:
press TRAVERSE and DOWN-RIGHT button	s		
for vertical alignment of work cage			
with motor. Man #3 - use sling to		***************************************	-
fasten hoist lugs on motor to hoist			
ring on elevator work cage.			-
B) a. Equipment room personnel will	Visual, tac	tual Silo bas	e p er son
disconnect all power to work		will det	ermine 1
cage at instigution of per-		ongs is	resting
sonnel at silo base.		sile flo	or.
b. Personnel at base of silo will	Audi tory		
communicate with equipment			
room personnel to assure power			
has been disconnected.	-	enter sur	
c. Personnel (silo base) will	Vac tual	Determin	e adequa
attach a tagline to hoist on		of taglin	ne attac
work cage.		ment and	point o
		attachme	nt.
d. Personnel (silo base) will	tectual,	Minimal	
then disconnect hoist cable	kinesthetic	_	*
and power and communication		•	•
cable	•		* *
	٠	•	



					<u> </u>
PERCEPTUAL REQUIREMENTS	DECISION RECTIREMENTS	a ct ion Work force	Communications Requirements	Safety Requir ements	PROBABLE ERRO
e Visual, tactual	Placement of lad-	Placement of ladder;	Voice communication	Adequate caution in	Careless use of]
	der for maximum	attachment of hoist.	between two personnel	use of ladder and care	inadequate cautic
tion	efficiency during	Depress controls.	at base of silo.	in attachment of hoist	_attachment of all
	operation. De-		Possible requirement	and sling.	and safety belt.
	termine alignment.		for voice communica-		to wear safety be
nd	Determine adequacy		tion with personnel		work come or on]
} 	of sling fastening.		in equipment room.		1
tons					4
ge					
50					
.s t	• • •	•			
					:
	~				
Visual, tactual	Silo base personnel	Pull circuit	Receive message	None	No circuit breake
• • · · · · · · · · · · · · · · · · · ·	will determine work	breakers.	(voice) that work		pulled; wrong cir
	cage is resting on		cage is resting on		breakers pulled.
	sile floor.		silo floor.		
Anditory		Communicate with	Send and receive	None	Garbled communica
· · · · · ·		personnel in equip	- (See Action col-		tions.
· •		ment room; receive	_	•	
	•	confirmation of	•		
•		power disconnect.			
Tac tual	Determine adequacy	Attach tagline	None	None	Inadequate attach
-	of tagline attach-	to hoist cable.			ment: cable lengt
•	ment and point of				would be insuffit
	attachment.				for manipulation
tectual,	Minimal	Hoist: remove	None	Must have received	
kinesthetic	•	hook. Power &		incontrovertible evi-	Bend or breek con
		communications.		dance of power dis-	nector pine on di
•	•	wrist rotation,		connect.	connect.
		abduction.			



TASK ANALYSES OF OPERATIONS ASSOCIATED WITH 10-FOOT DEEPER SILC - WING V

N AT SILO BASE BASE)	PERCEPTUAL REQUIREMENTS	DECISION REQUIREMENTS	ACTION WORK FORCE	COMMUNICATIONS REQUIREMENTS	Sapriy Requir ements	•
ive motor requires	Visual, tactual	Placement of lad-	Placement of ladder	; Voice communication.	Adequate caution im	C
re would require		der for maximum	attachment of hoist	. between two personnel	use of ladder and car	t P
ws: Man #1 - position	X	efficiency during	Depress controls.	at base of silo.	in attachment of hois	\$ _ a
nder motor. Vear		operation. De-		Possible requirement	and sling.	· .
ounting ladder.		termine alignment.		for voice communica-		. 1
UP-LEFT switch and		Determine adequacy		tion with personnel		. 1
tely 30 feet. De-	**************************************	of sling fastening.		in equipment room.		
nd DOWN-RIGHT button	<u></u>	<u>. </u>		-		
grament of work cage		AT				
#3 - use sling to			_			
s on motor to hoist						
work cage.			-		-	;
m personnel will	Visual, tactual	Silo base personnel	Pull circuit	Receive message	None	; ,
l power to work		will determine work	brea ker s.	(voice) that work	•	
gation of per-		cage is resting on	-	cage is resting on		1 : 1
o base.	-	sile floor.		silo floor.		
base of silo will	Auditory		Communicate with	Send and receive	None	, G
ith equipment			personnel in equi	p- (See Action col-		1
1 to assure power	•		ment room; receive	e wmn).		۴
onnected.	_	÷ •	confirmation of			
**************************************			power disconnect.			
lo base) will	Tactual	Determine adequacy	Attach tagline	None	None	1
ine to hoist on	<u> </u>	of tagline attach-	to hoist cable.			I
		ment and point of			-	¥
·		attachment.				,
lo base) will	tectual,	Minimal	Hoist: remove	None	Must have received	ī
ct hoist cable	kines the tic		hook. Power &		incontrovertible evi-	
. communication			communications:		dence of power dis-	a.
•			wrist rotation,		connect.	۵,

,	+				
Afety Ir ement s	PROBABLE ERRORS	JOB AIDS OR TOOLS	MORMAL SILO	VS DEEPE	R SILV WING-V
e caution in	Careless use of ladder;	Hoist, sling, safe-			• • • • • • • • • • • • • • • • • • • •
ladder and care	inadequate caution in	ty belt,			er - Camarie III General Cama angunan and in dec interpreparation and
		oist	•	•	
18•	and safety belt. Failu	re			- AT SET USE - FEET THAN AND ADDRESS AS A SET OF SET OF SET
	to wear safety belt in				
	work cage or on ladder.				
	· •				
	,				•
	•				
			The second district of the second of the sec	T To the second select control of second	
	•	<u> </u>		The same of the sa	
	•	#e #e -			
	No circuit breakers	None			
	pulled; wrong circuit	none.		a - 6 7 4 47	
,	breakers pulled.			-	
	arcovata burrian.				
•		· · · -	material and the second		
	Garbled communica-	wone_			
	tions.		m was the second of the second		
	+		· · ·		
				e commence o commence de	
		<u></u>	· · · · · · · · · · · · · · · · · · ·		
	Inadequate attach-	Tauline	~		
	ment: cable length				-
	would be insufficient	· ·			
	for manipulation.				
ve received.					
overtible evi-	Bend or break con-	Torque wrench	k .		
f power dis-	nector pins on dis-				
•	connect.				
				,	· · · · · · · · · · · · · · ·
			-,		
		C4: REVISED	DATE)12E 7.4 CO	J'T'
		T	+ +	7.4 4	- 1.
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		Aps.		EATTLE 24 WASHINGTON	P34

UNCTION D ORK CAGE UTILIZATION AT SILO BASE (LAUNCH TUBE BASE)	PERCEPTUAL REQUIREMENTS	DECISION REQUIREMENTS
B) Continued		
e. Personnel will remove toel kit	Visual, tactual,	Approximate ali
and items of excessive weight	kinesthetic	ment of cage vi
from work cage, and manually		motor.
maneuver cage into position im-		, , , , , , , , , , , , , , , , , , , ,
mediately below azimuth drive		
motor. Replace tool kit, etc.		
f. Equipment room personnel will	Visual, tactual	Approximate ali
attach line to traversing motor,	The second section of the section of	ment of travers
and utilize this line to pull		motor with work
work cage traverse motor until		cage.
it is in vertical alignment with	 	
work cage, immediately above	r · ·	· · · ·
azimuth drive motor.		
g. Personnel at silo base will	Visual, tactual	Evaluation of
reconnect hoist and power and		connect operati
communications cables.		•
		•
h. Informaçuipment room personnel	Equipment room	
h. Inform equipment room personnel of connection. Equipment room	Equipment room	
		·
of connection. Equipment room	personnel:	Maximal heighth
of connection. Equipment room personnel reconnect power.	personnel:	Maximal heighth
of connection. Equipment room personnel reconnect power. i. Enter work cage and attach safe-	personnel: auditory, tactual	Maximal heighth
of connection. Equipment room personnel reconnect power. i. Enter work cage and attach safe- ty belt, depress UP-LEFF switch and hold until maximum ascent is	personnel: auditory, tactual	Maximal heighti
of connection. Equipment room personnel reconnect power. i. Enter work cage and attach safety belt, depress UP-LEFT switch	personnel: auditory, tactual	Maximal heighth



	PERCEPTUAL REQUIREMENTS	DECISION REQUIREMENTS	ACTION WORK : FORCE	COMMUNICATIONS REQUIREMENTS	SA FETY REQUIREMENTS	PROBABLE EPROR:
	Visual, tactual,	Approximate align-	Remove excess items	·		Drop items being 1
	kinesthetic	ment of cage with	from work cage.	· ·		moved from cage.
		motor.	Move cage manually.	-		alignment of cage
•	• •		· · • •	No. of the control of	***	motor.
* -		· · · · · ·	·	- •		umm de ur description
						•
-	Visual, tectual	Approximate align-	Attach line; pull	Possible check with		Line not adequatel
.,		ment of traverse	motor to desired	personnel below.		attached: misaligr
<u> </u>		motor with work	position.			
_		cage.	-	-		
a 7						-
					•	
-						;
	Visual, tactual	Evaluation of	Hoist: insert			Bend or break con-
		connect operation.	hook; power and			nector pins; fail
			communication:			connect hook.
			push connector			
			parts together;			
	•		rotate kmurled			
			nut to complete		·	
			connection.			
	Equipment room		Connect power.	Receive		Garbled communica-
	personnel:		-			tion; failure to
	auditory, tactual		•			connect power.
		Maximal heighth.	Depress button.		Requirement for wearing	Press wrong button
-		<u> </u>	wope out wattam.		safety belt.	Failure to wear sa
s					SORRENT NOT 66	
Þ						ty belts.

Legy Chempats	PROBABLE EHRORS	JOB AIDS OR TOOLS	NUMBAL SILO	YS	DESPER SILO WING V
	Drop items being re- moved from cage, Mis- alignment of cage with		Not applicable	ment)	
	motor.				
	Line not adequately attached: misalignment.	Tagline	Not applicable		relationships (align-
:		. ·			
	Bend or break con- nector pins; fail to	Torque wronch	Not applicable		connection of electri-
	connect hook.	-			
	Garbled communication; failure to connect power.		Not applicable		
nt for wearing	Press wrong button. Failure to wear safe- ty balts.	Safety belt (stan- dard for work cage.	Not applicable	Spatial	relationships
				. ,	
		Cox RE	VISED DATE FIGL	TE 7.4	CON'T.

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P 35

	NCTION: D RK CAGE UTILIZATION AT SILO BASE (LAUNCH TUBE BASE)	Perceptual Requirements	DÉCISI ON REQUIREMENTS
6)	Loosen and remove bolts fastening	Visual, tactual	, Point of opera
	azimuth drive motor and first stage	kinesthetic.	at which motor
	gear reduction to base support ring	•	quires suppert
	Ease motor into suspended pesition.		
_	Stow all nuts, bolts, etc., in		The Company of the Co
	pouch.		
74)	Ladder is hoisted. Procedure is		
	reverse of step number 4 (Function		· · · · · · · · · · · · · · · · · · ·
	D). Two men ascend in work cage.	<u>-</u> <u>-</u>	
7B)	Personnel in work cage will de-	· · · · · · · · · · · · · · · · · · ·	
	press DOWN-RIGHT switch and bring		•
	work cage to rest on silo floor.		•
	Steps detailed under 5B (Function		
	D) will be performed in reverse		
	order.		.
8)	Lowering of azimuth drive motor		
	will be the reverse of raising.		
9)	Replacing of szimuth drive motor will be reverse of removal.		
10)	Check azimuth drive moter by per-	Visual, tectual	Evaluate mecha:
~	forming steps 1 through 3, inclu-		ical response
	sive, of para. 5, page 11, D2-14702.		follow sequence
			Time estimate
			(ninima)



of the 4 M At 17 to

^{*} Step 7A applies to Wings I through V, regular sile; step 7B applies to Wing V deeper sile.

TASK AWALYSES OF OPERATIONS ASSOCIATED WITH 10-FT DEEPER SILO - WING V

	Perceptual Requirements	DECISION REQUIREMENTS	ACTION WORK (FORCE	Communications Requirements	SAVETY REQUIREMENTS	PROBABLE ERRORS
	7isual, tactual,	Point of operation	Remove bolts, etc.		Care on ladder while	Lack of care in dis
	kinesthetic.	at which motor re-	Ease motor to full		guiding motor. Safety	mounting motor. R
g.		quires suppert.	suspension. Stow		belt.	pre to wear safety
•		and the same of th	loose bolts, etc.		and the same of th	
						van er pro-v
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	Visual, tactual	Evaluate mechan-	Follow steps in			Activate wrong con
	–	ical response and	procedure: acti-			Inadequate adapter
02.		follow sequence.	vate controls.	•		look down, incomple connection of cable
		Time estimate	Engage adapter			Failure to close c
	· - · · ·	(minimal)	ring. Lock			preser.
			downs. Connect cables. Close			, WA WORKS A
-			circuit breaker			•
			crient o presser			•

regular silo;

2

JAP STI JIHME ST S	PROBABLE ERRORS	JUB LIDI OR TOOLS	NORMAL SILO	٧s	DEEPNR SILO VING V
ladder while	Lack of care in dis-	Hoist, sling, ta-	· · · · · · · · · · · · · · · · · · ·		
notor. Safety	mounting motor. Fail-	line, ladder, wrench,			
	ure to wear safety belt.				
	same - and -	- · · · · · · · · · · · · · · · · · · ·	115	*****	
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	r =				The second section of the section of the second section of the section of the second section of the secti
	•	•		* / *** *- **	
			No management when a second or se		
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•				• • •	
-	Activate wrong control.	Possible towns	·		
	Inadequate adapter ring		entrans a self or		
	lock down, incomplete				
	connection of cables,	HO & GAGTTONTA	***		
	Failure to close circuit				
	breaker.		- -		
	, MA WORKIA &				*
	•	1		** ** **	- · · · · · · · · · · · · · · · · · · ·
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e 36

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Function: E Installation & Maintenance of Sun Inster-Communications Jack Box	PERCEPTUAL REQUIREMENTS	DECISION REQUIREMENTS
1) Operator utilizes work cage to	. Vision and touc	h Must maintain ho
install extension cable to SIN		alignment to mui
inter-commission Jack Box		clamp holes.
2) Install SIN inter-communication J-Box to sile wall using four		h
phillips head ecrews.	ar men unter Manusch mit erweiten. A. v 1986 . 1986 . 1986 . 1	
3) Remove cover and wire box (4		•
alotted head screws required).		where. Highly
		oritical opera-
		tion. If not
		correct, commun.
		cation will not
		exist.
State Control of the	-	
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and the state of t		
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	CEPTUAL IREMETS	DECISION REQUIREMENTS	ACTION WORK MORCE	Communications requirements	Safett Requirements	PROBABLE ERROR
Vision	and touch	Must maintain hole alignment to suit	.Two holes must be drilled into con-	If SIN communication is considered necessary	Safety lanyard must : be connected to ring	Difficult to align holes when working
		olamp holes.	14 inch intervals.	at the operational site		from a moving plat
	and touch				- · · · · · · · · · · · · · · · · · · ·	-
Vision	and touch	where. Highly critical opera-	Maintenance is reversed of steps 2 and 3 (Function E)	Oral communication between operators.	electrical power should be discon-	Color coding on wire.
		correct, communication will not				

eapett Uirements	PROBABLE ERRORS	JUB AIDS	OR TOOLS	Nuknal SILO	VS	DEEPER SILO	WING V
ty lanyard must	Difficult to align	Star drill,	hammer,				
onnected to ring	holes when working	screw drive	r.				
wheeler in 1740	from a moving plat-						
	form.						
		.					
- 1	•						
							-
	•		· · · · · · · · · · · · · · · · · · ·			·	
			 -	and the state of t			
trical power	Color coding on	Wire stripp	ers, screw				
ld be discon-	wire.	driver.					
ed.		-	- ••				
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P 37

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INS	CTION: P TALLATION AND MAINTENANCE OF ION SENSING TRANSDUCERS	PERCEPTUAL REQUIREMENTS	decision requirements
1)	Operator utilizes work cage to in-	Vision, touch	Must maintain
	stall lowest level Motion Sensing		hole alignment
	Transducer, using 4 phillips head		suit clamp hole
	8CT9W8		
		···	
2)	Remove cover and wire box.	Vision, touch	Which wires go
			where?
		Admir dans - Advance - Adv	
		- · · · · · · · · · · · · · · · · · · ·	
			
		-	
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	en contract of many sections and the section of the	-	-
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TASK ANALYSES OF OPERATIONS ASSOCIATED WITH A 10-FT DEEPER SILO - WING V

PERCEP REQUIRE		DECISION REQUIREMENTS	action work / Force		ommunecations rejuirements	3	Safety Requirements		PROBABLE ERRORS
Viaion,		Must maintain hole alimment to suit clamp holes.	Four holes must be drilled into concrete.		commissic	B. (Safety langard mus connected work cag yoke ring.	.	holes alignment when working from a move
Vision,	touch	which wires go	For maintenance remove faulty	Oral	comunicatio	on . —	The space space of the space of	- 	. Color coding on wi
		· · · · · · · · · · · · · · · · · · ·	replace.			-	e e e e		
- -									
							-		·
	-								•
								•	



TETY TREMENTS	PROBABLE ERRORS	JOB AIDS OR TOOLS	NCHMAL SILO	VS DEEPER SILO WING V
lanyard must be	Difficult to maintain	Star drill, hammer		Transducer is 14 feet from
rd work cage	holes alignment when	and screw driver.		silo floor rather than 6 feet.
1g	working from a moving			
	platform.			
page and agreementation is use on adjustmental	Color coding on wire.	dire strippers, open		- The second sec
	gaphysphore on one w	end wrench.		a superior and the superior of
	÷ .			
,			The regular post of the Control of t	
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τ	i		Ţ			FIGURE 7.6	·
_ [⊆+k	ļ		ĺ		1	SECURITY TRANSDUCER	<u>.</u>
Asis	Ţ		 ĺ		1_ 1	THE BUEING COMPANY	2.5-12.135
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PREPARATION & REMOVAL OF MISSILE	PERCEPTUAL REQUIREMENTS	DECISION REQUIREMENT
1) Descend in properly prepared work	Vision, touch	Has a proper
cage to a point opposite missile ti	9-	ground contac
point junction box on sile wall.		been establis
Attach earth ground cable to ground	• • . ==	Do I know pro
ing strap on outside of missile sup-	• • • • ·	attach points
port ring adapter and to connector		
lugs in tie-point junction box.		
2) Attach missile skirt grounding	Vision, touch	Has a proper
strap to grounding clip on inside	, 	ground contac
of missile support ring.		been establis
a are the area of the second o		Do I know pro
		attach points
3) Install hoist support hook on	Vision, touch	Is hoist sup
receive ring and missile base		hook flush wi
support ring.		receiver ring
		missile base
		port ring.
4) Hand torque adjustment nut	Vision, touch.	Is this force
to maximum possible torque	A great variance	sufficient to
to insure adequate preload-	may exist be-	meet requires
ing.	tween hand torque	of the T.O.?
	ability of vari-	
	ous air men. An	
	adjustment nut	
	torque study shou	<u>l</u> a
	be made to ascert	in
	requied torque and	
	5th to 95th percents	ile
		-

^{*} Function G is to be reversed for Missile Preparation for Emplacement



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TASK AWALYSES OF OPERATIONS ASSOCIATED WITH 10-FOOT DEEPER SILO - WING Y

PERCEPTUAL REQUIREMENTS	decision requirements	ACTION Work Force	COMMUNICATIONS REQUIREMENTS	SAFETT REQUIREMENTS	PROBABLE REPORS
Vision, touch	Has a proper earth	Manual commection	Telephone with micro-	Protective head gear	Poor ground attack
de-	ground contact	of earth ground	phone headset.	worn. Safety langard_	made.
	been established?	cable.	<u>.</u> .	attached to work cage	
id-				ring. Safety shoes.	
13	attach points?	-			
			·		
			· ·		• • • • • • • • • • • • • • • • • • •
Vision, touch	Has a proper earth	Mamual connection	Telephone with micro-		Poor ground attach
,	ground contact	of earth ground	phone headset.		made.
	been established?	cable.	MATINE IN THE SECOND SE	- wherether alley more to	
	Do I know proper		•	The state of the specific of t	
	attach points?		-		
				-	
Vision, touch	Is hoist support	Manual manipula-	Telephone with micro-	- · · · · · ·	If hoist support h
	hook flush with	tion of hoist	phone headset.		is properly seated
	receiver ring and	support hook.			error possible.
	missile base sup-				
	port ring.		_		•
Vision, touch.	Is this force	Hand torque ad-	Telephone with micro-		Loose adjustment n
A great variance	sufficient to	justment nut	phone headget.		
may exist be-	meet requirements				:
tween hand torque	of the T.O.?				
ability of vari-					ı
ous air men. An					
adjustment nut					
torque study shou	<u>l</u> a				
be made to ascerta					-
requied torque and	1		,		
5th to 95th percents	lle				

dissile Preparation for Emplacement

man adequacy.

SAFETT QUIRENETS	PROBABLE EFFORS	JOB AIDS OR TOOLS	HORMAL SILO	YS	DEEPER SILO	VIDE Y
ive head gear	Poor ground attachment	Basic knowledge of elec-		See		
Safety langard	made.	trical circuitry. Tech-				
to work sage		nical Manual, tool kit,				
Safety shoes.		sling rod cover set.				
						
			· · ·			
<u>.</u>						
The second second second second	Poor ground attachment	J				
	made.	trical circuitry. Tech-	<u> </u>			
1		nical Manual, tool kit,				
	-	sling rod cover set.				
					· ·	
production of the second of th	If hoist support hook	Normal mechanical skills.		Same	9	
	is properly seated no	AF number not available.				
	error possible.					
						-
						· • · · · · · · · · · · · · · · · · · ·
	Loose adjustment nut.	Sufficient hand torque		Sam	•	**
		force to tighten to	and the second second second second			
,, <u>.</u>	4	maximum expected.				
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P 31

PREPARATION & REMOVAL OF MISSILE	PERCEPTUAL REQUIREMENTS	decision requirements
5) Attach hoist chain to hoist support	Vision, touch	Is it attacked
hook.		
•		
CAUTION: Use extreme care when handling	minoile	nor - a scalinor - po mante Miljonio delle e can discolidentami
skirt umbilical cable head in steps 6 t		
Cable head contains shear pins which me		
if cable head is bumped, pulled or other		
handled.	The state of the s	
	· ··· · · · · · · · · · · · · · · · ·	····
6) Position lower cable grip around	Vision touch,	Insure cable po
missile skirt umbilical cable with	good illumina-	sitioned cerre
cable grip lanyards ur.	tion.	ly.
7) With rawhide lace, lace from top	Vision, touch	Insure that di
down in a criss cross pattern	was	tance is appro:
through approximately every third	·	mately four fe
loop and secure rawhide lace with	• •	
a square knot. Distance between		
umbilical head lanyards and cable		
grip lanyard shoudl be approximate-		
ly four feet.		
8) Extend chain hoist and attach hook	Vision, touch	
to lanyards.		
	 	a company of the comp
PROPERTY HE serve an executation and a contract of the contrac		
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TASK ANALYSES OF OPERATIONS ASSOCIATED WITH 10-FOOT DEEPER SILO - WING V

						<u> </u>
	PERCEPTUAL REQUIREMENTS	DECISION RE JUIREMENTS	ACTION WORK FORCE	Communications Requirements	Sapett Bequir egeres	PROBABLE ERRORS
rŧ	Vision, touch	Is it attached?	Manual connection	Telphone with micro-	Protective head rear	No prebable error
				phone headset.	vorn. Safety language	
				· · · · · · · · · · · · · · · · · · ·	attached to work case	
					ring. Safety shees.	
	minatia					
	missile	and the second s			,	
	rough 14.				,	
	be sheared				and the same of th	
Ter	wise mis-			Allenda Allenda era eralden der eller eregeligt delle senten de seu eralden		
			The same of the sa		and a superior of the superior	1 ,
	Vision touch,	Insure cable po-	Manual manipu-	annium		See Cautien Note pr
ħ	good illumina-	sitioned correct-				ceding Step 6.
-	tion.	7			agu agu considera — sa di manasandalah mismi sa mismi ga considera an algorith misigalah din d	
	• •	. •	· ·	e is more as une as anno un a un e un esque as s	and the second section of the second control	
	•					,
	Vision, touch	Insure that dis-	Manual manipu-	The same of the sa		See Caution Rote p
•		tance is approxi-			the second secon	ceding Step 6.
		mately four feet.				4.
1						
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			lation.		rand der deusge aus er stillenbergen der de kallende um eine kandelstellenbergepreite der besche der der	beding Step 6.
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APRIT DOMESTICS	PROBABLE ERRORS	JOB AIDS OR TOOLS	NORMAL STLO	VS DECEMBER SELLO	wing #
re head geer	No prebable error	Manual-visual coordi-		Seme	3
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ayaan saanigada —adigaagaadaaninininininingaagaa kan asabindhiin aga aka	coding Step 6.	- Basic knowledge of elec- trical circuitry, Tech-		3684	
	georns stab o.	nical Manual, tool kit,			
	1	sling rod cever set.			
		DILING I'VA GOVAL DOVE	an in the secondary makes a section, where we describe again transfer, again		
	See Cantion Hote pre	- Manual-visual coordi-		Same	
	ceding Step 6.	nation.			
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	See Caution Hote pre	- Manual-visual coordi-		Samo	
	weding Step 6.	nation.			
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	ICTION: 0 EPARATION & REMOVAL OF MISSILE	Perceptual Requirements	DECISION REJUINMENTS
9)		Vision, tough	bilical veight
10)		Vision, tough	
	loosen bolt and swing clamp clear of missile skirt umbilical.		
	Remove bolts and remove umbili- cal head lanyards from bolts; reinstall bolts.	good illumination	
	Remove umbilical head threaded receptucle from raceway cable connector with strap wrench.		
.4)_	be installed. Install can.	Vision, touch good illumination	
	Lower umbilical cable until clear of missile base support and disconnect cable grip lanyards from chain hoist hook.	Vision, touch	
	NOTE: Lower cable grip assembly/shal skirt umbilical cable until skirt um		

^{*} When missile skirt umbilical cable requires maintenance steps 10 through 13 should be included in umbilical cable Remove/Replace procedu:



good illumination bilical weight phone headset. is on hoist. Vision, touch Bolts are loosened Manual and meananged illumination fundition Vision, touch Clear is clear Manual and meananged illumination of unbilical ical manipulation Vision, touch Becheck to be good illumination sure bolts are reinstalled. Vision, touch Are threads Manual manipulation Vision, touch Are threads Manual manipulation good illumination stripped? Vision, touch Manual manipulation Wanual manipulation Cap is loose Vision, touch Manual manipulation	PERCEPTUAL REQUIREMENTS	DECISION REQUIREMENTS	ACTION WORK FORCE	COMMUNICATIONS REQUIREMENTS	Safety Requirements	PROBABLE ERRORS
Vision, touch Clump is clear Manual and measure- good illumination of unbilical ical manipulation Vision, touch Recheck to be good illumination sure bolts are reinstalled. Vision, touch Are threads Ranual manipulation good illumination stripped? Vision, touch Are threads Ranual manipulation good illumination stripped? Vision, touch Manual manipulation good illumination Vision, touch Manual manipulation Vision, touch Manual manipulation Vision, touch Manual manipulation Cap is loose	Vision, touch	Insure that wa-		Telephone with micro-	Protective head gear	See Caution Note pre
Vision, touch Solts are lossened Manual and mechangoed illumination ioel manipulation Vision, touch Chap is clear Manual and mechanged illumination of umbilical ioel manipulation Vision, touch Recheck to be Manual manipulation Vision, touch Are threads Manual manipulation good illumination stripped? Vision, touch Are threads Manual manipulation good illumination stripped? Vision, touch Manual manipulation Cap is losse Vision, touch Manual manipulation	good illumination	bilical weight		phone headset.	vorn. Safety lanyard	ceding Step 6
Vision, touch Clump is clear Manual and mechan- good illumination foundition Vision, touch Clump is clear Manual and mechan- good illumination of umbilical feal manipulation Vision, touch Recheck to be Manual manipulation Vision, touch Are threads Manual manipulation good illumination stripped? Vision, touch Manual manipulation Cap is losse Vision, touch Manual manipulation		is on hoist.			attached to work cage	
Vision, touch Cleap is clear Manual and measurement of unbilical ical manipulation Vision, touch Recheck to be Manual manipulation Vision, touch Are threads Manual manipulation Vision, touch Are threads Manual manipulation good illumination stripped? Vision, touch Manual manipulation Cap is loose Vision, touch Manual manipulation					ring. Safety shoes.	
Vision, touch Clump is clear Manual and median- good illumination of umbilical ical manipulation Vision, touch Recheck to be Manual manipulation good illumination sure bolts are reinstalled. Vision, touch Are threads Manual manipulation good illumination stripped? Vision, touch Manual manipulation Cap is loose Vision, touch Manual manipulation	Vision, touch	Bolts are loosened	Manual and mechan-			
Vision, touch Clump is clear Manual and mechanged illumination of umbilical ical manipulation Vision, touch Recheck to be Manual manipulation good illumination sure bolts are reinstalled. Vision, touch Are threads Manual manipulation good illumination stripped? Vision, touch Manual manipulation Cap is losse Vision, touch Manual manipulation	good illumination	and the state of t	ical manipulation	-	· · · · · · · · · · · · · · · · ·	
Vision, touch Chap is clear Manual and mediangeod illumination of umbilical idal manipulation Vision, touch Recheck to be Manual manipulation good illumination sure bolts are reinstalled. Vision, touch Are threads Manual manipulation good illumination stripped? Vision, touch Hanual manipulation Cap is loose Vision, touch Manual manipulation						
Vision, touch Recheck to be Manual manipulation Vision, touch Recheck to be good illumination sure bolts are reinstalled. Vision, touch Are threads Manual manipulation good illumination stripped? Vision, touch Manual manipulation Cap is loose Vision, touch Manual manipulation	na an a		**	-		
Vision, touch Recheck to be good illumination sure bolts are reinstalled. Vision, touch Are threads Manual manipulation good illumination stripped? Vision, touch Are threads Manual manipulation good illumination stripped? Vision, touch Manual manipulation Cap is loose	Vision, touch	Nam is clear	Manual and macana			
good illumination sure bolts are reinstalled. Vision, touch Are threads Nanual manipulation good illumination stripped? Vision, touch Hanual manipulation good illumination Cap is losse Vision, touch Manual manipulation					•	
good illumination sure bolts are reinstalled. Vision, touch Are threads Nanual manipulation good illumination stripped? Vision, touch Hanual manipulation good illumination Cap is losse Vision, touch Manual manipulation					-	
good illumination sure bolts are reinstalled. Vision, touch Are threads Nanual manipulation good illumination stripped? Vision, touch Manual manipulation good illumination Cap is loses Vision, touch Manual manipulation		•			÷	
Vision, touch Are threads Nanual manipulation good illumination stripped? Vision, touch Hanual manipulation Cap is losse Vision, touch Manual manipulation			Manual manipulation	ı		
Vision, touch Are threads Nanual manipulation good illumination stripped? Vision, touch Manual manipulation Vision, touch Manual manipulation Washington Manual manipulation			÷ .			-
Wision, touch Manual manipulation Vision, touch Manual manipulation Wasion, touch Manual manipulation			•			•
Vision, touch Manual manipulation Cap is losse Vision, touch Manual manipulation			Nanual manipulation	L		
good illumination Cap is losse Yision, touch Manual manipulation	-		,		•	
good illumination Cap is losse Vision, touch Manual manipulation	Vision. touch		Manual maninul tion			
Vision, touch Manual manipulation			Tames mark purchases	,		Cap is loose
Vision, touch Manual manipulation						•
· ·	Vision, touch		Manual manipulation			• •
good illumination	good illumination	-				

shall remain secured to bumbilical is reinstalled.

requires maintenance steps 10 milical cable Remove/Replace procedures.



eny Lhents	PROBABLE ERRORS	JOB AIDS OR TA OLS	NORMAL SILO	٧s	DETER SILO WIN	YG V
e head gear	See Caution Note pro-	Manual-visual coordi-			Same	
fety lanyard	ceding Step 6	nation	·			. -
to work cage			· · · · · · · · · · · · · · · · · · ·			
fety shoes.				Name - to Management - Santa - to -	~	
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	Cap is loose		<u>. </u>			
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FUNCTION: 6 PREPARATION & REMOVAL OF MISSILE	PERCEPTUAL REQUIREMENTS	decision requihements
16) Remove chain hoist from hoist sup	- Vision, touch,	
port hook and remove hook from re	- good illuminat	ion
ceiver ring and missile base supp	ort.	
17) Swing umbilical clamp-half into	- · · - · · · · ·	
place and tighten clamp-half bolt		
Tighten clamp bracket bdts.		
18) Operate power azimuth drive con-		Try to get a
troller, visually positioning		close to cen
missile raceway halfway between	·	as possible.
support arms 1 and 2.		
19) Align center or receiver ring ear	· · · · · · · · · · · · · · · · · · ·	Is tolerance
that is newest arm 1 with center	-	within ± ½ j
line of arm 1 within + one-half	·	
inoh.		
20) Return to base of missile and		Is tolerance
verify step 19. If ear is not		within <u>+</u> ½ i
centered, rotate missile as	<u>.</u>	
necessary.		-
21) Position adapter ring to missile		Attachment
skirt clamps set. Bolts attachin	&	been made a
missile skirt to missile support		bolts only
ring adapter should be hand tight	:-	tight.
ened.		
	1	-

TASK ANALYSES OF OPERATIONS ASSOCIATED WITH 10-FOOT DEEPER SILO - WING Y

<u> </u>	PERCEPTUAL REQUIREMENTS	DECISION REQUIREMENTS	ACTION WORK FORCE	C MMUNICATIONS REQUIREMENTS	safety Requirements	PROBABLE ERROS
nip-	Vision, touch,		Manual manipula-	Telephone with micro-	Safety shoes, hat	1
re-	good illuminat	ion	tion	phone headset.	and lanyards.	
ipport					ده معمد بایات	
# F ~ ·						
			Manual manipula-			
olt.			tion.		anno antono en esta com	
÷				<u>-</u>		
		-				- r
 1-		Try to get as	Manual manipula-		_	Error in visual
7 -		close to center	tion and visual		4	ment would requir
n	-• - · · · · · · · · · · · · · · · · · ·	as possible.	judgment			more time on step
						19 and 20.
	. .					-
ear		Is tolerance	Fine manual mani-			Won't be within
ter-	-	within + ½ in.	pulation			ance necessary in
f			*			Step 20.
	<u>.</u>	•	-			
	- · ·					
_		Is tolerance	Manual-visual			Judgment error
	-	within+ ½ in.	manipulation			
		-	-	,		
•	_					
	•	-				
le.	·	Attachment has	Manual manipulı-			
hing		been made and	tion			1 •
rt	- · ·	bolts only hand				
ght-		tight.				
- T		* .				

PETY REMENTS	PROBABLE ERROS	JOB AIDS OR TOOLS	normal silo	V S	DEEPER SILO WING V
shoes, het	1	High manual-visual			
yards.	<u> </u>	coordination, plus Step 1 of this Function			
* · ·					en mari pur regenera de ser a esta de la versa de de
-	2 · · · · · · · · · · · · · · · · · · ·				ente de entre en un marie de un marie de describe de
	and the second of the second o	The same and the same same and the same and			
		Annual designation of the second and	_ A 4 WOV - N- NO AND		al de l'Alle annual de la company de la comp
	•				
	Error in visual judg-				
a shape	ment would require				
	more time on steps				
-	19 and 20.				
	Won't be within toler-			·	
	ance necessary in				
	Step 20.				
		~			
	Judgment error				
					•
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		REVISED	FIGUR	E 7.7	7 CON'T
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FUNCTION: C PREPARATION & REMOVAL OF MISSILE	PERCEPTUAL REQUIREMENTS	DECISION REQUIREMENTS
22) Torque 16 clamp set bolts to 1200	Vision, touch,	Torquing is co
(+ 50) inch pounds	good lighting	rect and torqu
		wrench is with
		calibration da
23) Adjust each positioning post to	Vision, touch,	Alignment is
fixed position by removing adjust-	good lighting	correct
ment nut lookpin and turning adjust	>	
ment until positioning pin can be		
installed in positioning post. In-	•	
stall positioning pin.		
24) Install adjustment nut lookpin and remove positioning pin from positioning post.	• • -•	Alignment is
25) Feed quick release pin and posi-	Vision, touch.	- Alignment is
	good lighting	correct
down through mounting bracket on		
missile support ring adapter.		·
26) Continue feeding positioning post	Vision, touch,	Alignment is
until quick release pin hole in	good lighting	correct
positioning post aligns with hole	••	
on side of mounting bracket. In-		-
stall quick release pin.		
		-



	PERCEPTUAL REQUIREMENTS	DECISION REQUIREMENTS	ACTION FORCE	Communications requirements	Sapery Requirements	PROBABLE ERR
00	Vision, touch,	Torquing is cor-	Manual Manipuls-	Telephone with micro-	Safety hat	Torque arror
	good lighting	rect and torque	tion	phone headset.		
		wrench is within				
		calibration date.				-
	Vision, touch,	Alignment is	Menual manipula-	Telephone with micro-	Safety hat	
et-	good lighting	correct	tion	phone headset.		
jusi be In-				-		
	Vision, touch, on-good lighting	Alignment is	Manual manipula- tion	Telephone with micro- phone headset	Safety hat	
• • •	Vision, touch, good lighting	Alignment is correct	Manual manipula- tion	Telephone with micro- phone headset.	Safety hat	
st le	Vision, touch, good lighting	Alignment is correct	Manual manipula- tion	Telephone with micro- phone headset.	Safety hat	

Saperi Quir e ments	PROBABLE ERRORS	JOB AIDS OR TOOLS	NORMAL SILO	YE	DEEPER SILO	WING V
hat . T	orque error	Mechanical visual-		Same		
		manual				
	-					
at				Same		
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		Co./ REVISED	FIGUR	ZE 7.7	CONT	<u> </u>
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	Tion: C Aration & Removal of Missile	PERCEPTUAL REQUIREMENTS	DECISION REQUIREMENTS
27)	After pre-removal operation at top	Proper lighting,	Judgment of
	of silo have been completed, an	virton, touch,	clearance
	observer will be slotted in laucher-	- audio.	
	equipment room. Headset communica-	> ,	
	tions will be established between	en e	
	this observer and operator of hoist		
	rods (at ground level) in order to	· · · · · · · · · · · · · · · · · · ·	
	inform operator of clearances at	- · · · · · · · · · · · · · · · · · · ·	-
	milo base.		
A)	Attach hoist sling rods to mating	Dunnam lighting.	Ama aling mod
<u> </u>	missile support ring adapter fitting		· - · · · · · · · · · · · · · · · · · ·
	as fellows:	audio	dition before
	a) Take missile grounding cable from	• •	attachment?
	T-E support truck and lower all	<u>.</u>	co d feminance as
	but 5 feet into the launch tube.		
	b) After lowering work cage to mis-	<u>-</u> -	Is proper eart
	sile base, attach end of ground-		ground establi
	ing calle to missile support ring		at both upper
	adapter.		ares and missi
		·	support ring.
	c) Stow permanent cable in work		A AND A TOTAL OF
	cage.		
	d) Remove sling rod ends covers and		To tie article
	stow in work cage.		down in work o
	e) Insure that hoist sling rods have	·	Are bolt holes
-	been lowered sufficiently for		clear of dirt
-	proper alignment of bolt holes in	L	not damaged? I
	mating fittings of sling rods and		alignment corre
	support ring adapter. If sling r	-	for connection
	will not mate it will be necessar		
-	to open centrol panel and depress		
	LOWER buttom until sling rod fitt		



adapter fitting.

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Perceptual Requirements	DECISION REQUIREMENTS	ACTION WORK FORCE	COMMUNICATIONS REQUIREMENTS	SAFETT REQUIREMENTS	PROBABLE ERROR
Proper lighting,	Judgment of	Establish communi-	Telephone with micro-	Protective head gear	Pauled hoisting gear
vision, touch,	clearance	cations	phone headset.	Safety lanyards while is	Damaged hoist rod e
- audie.				work cage. Are hoist	Frayed hoist oables
• 6				cables taut and free	not noticed?
				from all emenumbrances?	,=
t				Have any objects fallen	-
				from T-E which must be	•
				retrieved?	-
				-	• •
			- ***		
Proper lighting,	Are sling rod	Attach rod ends.	Telephone with micro-		-
ngs vision, touch,	ends in good con-		phone headset.		-
audio	dition before			-	
	attachment?				•
	• •	-		e-	
•					•
<u> </u>	Is proper earth	Make earth ground		••	Not attached correct
<u>.</u>	ground establish	ed attachment.			l y.
<u> </u>	at both upper si	lo			•
	area and missile				
-	support ring.				
			•	•	
d d	To tie articles	_			
	down in work cag	.		-	•
.Ve	Are bolt holes				Trouble with con-
	clear of dirt an	d			nection.
in	not damaged? Is				
and _	alignment correc	t		•	
rods	for connection?				
Mary					
88				1	
		-		1 4	



ttings ring

iy Maris	PROBABLE ERROR	JOB AIDS OR TOOLS	HOHMAL SILO	VS DEEPER S	IPO AIMS A
head gear		Tool kit, technical		Seme	
yarda while is	Damaged hoist rod ends	. manual, sling rod			
Are boist	Frayed hoist oables				
and free	not noticed?	placement.		· · · · · · ·	
cumbrances?			 		
jecte fallen	l				
nich wust be				<u> </u>	
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	· · ·				
		 .	and the same of		
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	•				
·	Not attached correct-	-	-		
	ly.	-			
			-	<u> </u>	
				-	
	•				
	Trouble with con-				7
	nection.			<u>.</u>	
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Function: G Preparation & Removal of MI: Sile	PERCEPTUAL REQUIREMENTS	DECISION REQUIREMENTS
28) Continued		
f. Remove sling rod mounting bolt		
and position sling rod fitting	A.	
in respective fittings on mig-		
sile support ring adapter.	- · · · · · · · · · · · · · · · · · · ·	
g. Install mounting bots attach-		
ing sling rods to ring dapter.		
h. Tighten mounting bolts and in-		Are bolts tight.
stall cotter pins.		-
i. Disengage adapter ring lock		Is handle out
downs by pulling handle out as		as far as possibl
far as possible and rotating		Is handle above
45 degrees from vertical in		gear teeth?
either direction. Handle must		
always be above gear teeth on		
receiver ring.		
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and the contract of the contra		



TASK AHALITSES OF OPERATIONS ASSOCIATED WITH A 10-FOOT DEEPER SILO - WING V

PERCEPTUAL 'AL OF MICSILE REQUIREMENTS		ACTION WORK OF FORCE	COMMUNICATIONS REQUIREMENTS	SAVSTI REQUIREMENTS
g red mounting bolts. Vision, touc	h	Manual-mechani-	Telephone with micro-	Safety hat and shoes
m sling rod fittings		cal manipulation	phone headset.	
ve fittings on mis-				
t ring adapter.				
nting bots attach-	-·-			
ods to ring stapter.			•	
nting bolts and in-	Are bolts tight			•
g pins.		-		
dapter ring look	Is handle out			
Illing handle out as	as far as possible	? .		
ible and rotating	Is handle above			
from vertical in	gear teeth?			
ction. Handle must				
bove kear teeth on	•			
ng				
AND THE RESIDENCE CONTRACTOR OF THE PROPERTY O				
	• •			

TASK AMALYSES OF OPERATIONS ASSOCIATED WITH A 10-FOOT DEEPER SILO - WING V

PERCEPTUAL REQUIREMENTS	DECISION REQUIREMENTS	ACTION WORK OF FORCE	Communications requirements	SA yeti Requir ements	PROBABLE ERROR
Vision, touch		Manuel-machani-	Telephone with micro-	Safety hat and shoes	*** * * * * * * * * * * * * * * * * * *
		cal manipulation	phone headset.	a amerika kanane kanansa	
			•		
· · · · · · · · · · · · · · · · · · ·	Are bolts tight			.* .	
					ī
	Is handle out				
	as far as possible?			•	
	Is handle above				,
	gear teeth?				•
		-			
		•			
	-				

PENY REMINIS	PROBABLE ERROR	JOB AIDS	OR TOOLS	NORMAL SILO	٧s	DEEPER SILO WING Y
at and shoes			visual-		Same	
		manual .				
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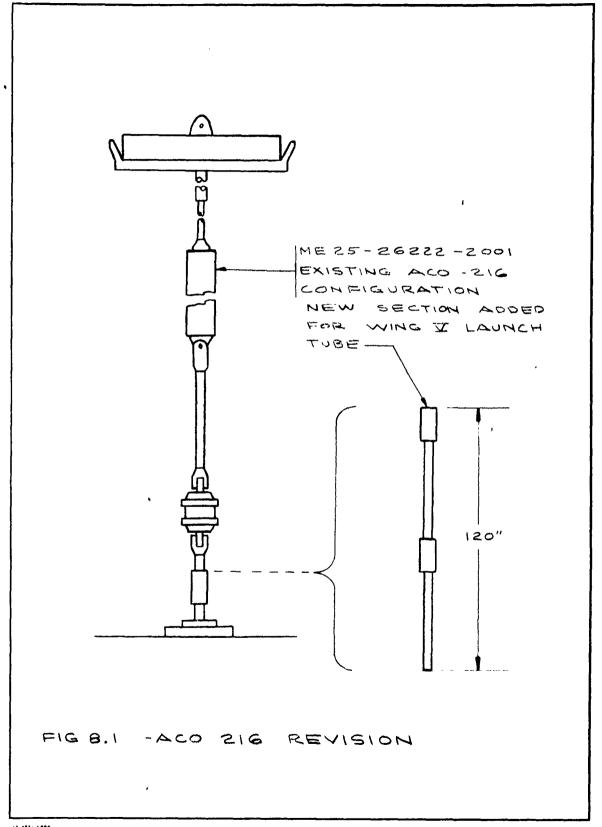
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	fen.			FIGURE 7.7 CONT.	
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- 8.0 ACO EFFECTS
- 8.1 ACC 216 FIXTURE, MISSILE SUSPENSION SYSTEM LOADING
- 8.1.1 Figure 8.1 depicts the new configuration required to make ACO 216 compatible with the desper launch tube. The required revision consists of adding an additional red and turnbuckle section to the existing linkage. Specific changes are:
 - (a) Two new linkage reds (each approximately 5 feet in length)
 - (b) Two additional ME 25-26228-213 turnbuckles
 - (e) New pallet or box to held reds and turnbuckles
 - (d) Reserved shipping fixture to held pallet or bex. Fixture will employ brackets to assist the assembly of sections prior to installing teel in launcher.
- 8.1.2 Change will be assumptished water NOP 559. Wing V A & CO requirements document will include this change in the basis release. A new ACO number (ACO 216.5) is recommended.
- 8.2 ACO 215 FIXTURE HOLE LOCATING, MISSILE SUSPENSION SYSTEM SPRING CAN
- 8.2.1 Pigure 8.2 depicts the new configuration required for ACO 215 targets. An additional circle has been added to the target to measure telerance.
- 8.2.2 The change is necessary because the deeper launcher emmed an increase in the missile suspension pulley bracket outof-tolorance requirement. This requirement is necessard by dropping plumbobs from the pulley brackets to the targets on AOO 215.
- 8.2.3 Change will be accomplished under ECP 559. A new ACC zamber (ACC 215.5) is recommended.
- 8.3 NO OTHER ACC ITEMS ARE AFFECTED.

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ACO 215-TARGET (3 PLACES) EXISTING CIRCLE -& GRID ADDED CIRCLE -FIG 8.2 - ACO 215 REVISION U3-407 1 1000

BOSING

TEST PROGRAM 9.0

9.1 Wing V testing will be required. At least one missile launch from a 90 foot deep launcher is recommended. This is necessary to verify the revised missile mount as well as to verify missile fly-out. Preliminary coordination for a Wing V test program has been conducted. (Reference: Telecon Severide/BSD Col. Stuber, 5-21-63).

> NOTE: No special testing is authorized at STP III, AMR er VAFB under the scope of this study decument and STL Document 6660,42-31 dated 3 January 1963.

- The results of this study indicate that no large scale 9.1.1 R & D test program is necessary to obtain data on the Wing V changes. It is therefore not necessary to bring STP III or AMR to a Wing Vn configuration solely as a result of the deeper launcher.
- Verification testing at VAFB is necessary to demonstrate 9.1.2 the validity of the analyses. This test progress should consist of one or more firings, with the following specific objectives:
 - (a) Demonstrate the systems capability and adequasy of the Wing V ten-foot deeper launcher configuration, including facilities, equipment, and technical manuals.
 - (b) Demonstrate by the successful laurah of a missile, that the Wing V configuration launcher does not preduce gas dynamic effects deleterious to the missile or missien.
 - (c) Demonstrate by the successful launch of a missile, that the Wing V configuration of the Support, Missile Suspension, Figure A 1322.5. operates satisfactorily during launch.
 - (d) Demonstrate that the personnel subsystem including QQPRI, training, technical data, and human engineering can provide the human performance required by the Wing V configuration.
- Launch Facility #7 (0000008) at VAFB is constructed to 9.2 the Wing V 90-fost depth, however, as shown in Figure hele a steel platform is installed ten feet above the

bottom of the launcher to provide a Wing III configuration. The facility will have to be modified to the Wing V configuration to support testing of the Wing V system.

9.3 The proposed LF #6 at VAFB (See Figure 4.1) would not be available early enough to support Wing V testing. Firings should be scheduled as early in the program as possible to allow time for fixes of any problems that eccur.

U3 4071 1000 (was BAC 1546 L-R3)